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NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

New York City next week will be the scene of what will probably be the most notable convention ever held by the National Electric Light Association. The accessibility and preponderating attractiveness of the great metropolis assure a heavy attendance, and the advance registration indicates a representation of record-breaking proportions. The excellent work of the committee on membership has brought the total membership above the 8,300 mark, and reservations on the special trains which have been chartered from distant points give every evidence of an enthusiastic participation of out-of-town central-station men and others interested in this development of electrical industry.

The program for the business sessions of the convention is given on another page, and even a casual review indicates that there will be plenty of work for those who will attend the convention with the idea in mind of participating in the reading of papers and the discussion of these and the many committee reports. The latter will form a most important part of the convention proceedings, particularly the report of the committee on public policy, as this will very likely establish definitely some line of action with respect to the working out of the problems affecting the welfare of employees.

Another feature that will attract great attention is the work of the Commercial Section. Although the most recent specific department into which the effort of the Association has been individualized, the interest in this phase of central-station work is very great and the status of the central-station men engaged in the new business departments is constantly growing in importance. On other pages of this issue an outline of the work of the Commercial Section is given, together with a number of short sketches delineating the principal incidents in the career of those who are contributing so earnestly to the building up of the value of the central-station new-business departments.

Apart from the serious side of the sessions, there will be many delightful diversions. The entertainment committee, headed by that most charming of entertainers, Mr. Arthur Williams, has prepared a program which will be in conformity with the resources and well known spirit of generosity of New York.

CENTRAL-STATION OPPORTUNITIES.

The central-station industry was primarily an electric lighting proposition. It began by supplying current to series arc-lighting circuits and to constant-voltage mains for the parallel operation of incandescent lamps. From merely night operation it expanded to all-day operation. As it came to be realized that the generators were heavily loaded for only a small fraction of the time, efforts were made to secure loads other than lighting, loads which were not confined to the dark hours. Such a load was to be found in the application of electric motors for power purposes in place of prime movers, and the efforts of central stations to secure business has undoubtedly hastened this development, a development which progresses year by year until few industries exist where electric drive has not found a place.

Industrial-power loads made all-day operation necessary and this in turn makes larger opportunities and larger demands for off-peak loads. Today the endeavor of the central-station manager is to find off-peak loads, and no avenue for the cultivation of this class of business should be left untrodden.

In addition to motor drive, which often must be operated over the peak and can seldom be classed as an off-peak load, opportunities for such loads may be classified under the heads of heating appliances; battery charging, with especial application to electric vehicles; electrochemical and electric-furnace applications, including the fixation of atmospheric nitrogen, and ice-making. While the latter is a case of motor-drive, it can, if operated by the central station, be confined to off-peak hours, and consequently forms a very desirable load. Another case of motor drive which can be operated intermittently, and hence can often be so arranged as to be kept off the peak, is comprised in a pumping load, either for irrigation or other purposes. Pumping for irrigation is of course not an urban necessity and is largely confined to a few Western states, so that this opportunity is open only to those few companies operating transmission lines, or having distribution net-works extending over large areas of territory.

Opportunities for electric-heating loads are confined largely to extensions of use of household appliances which can be attached to the ordinary lighting outlet. The revenue in such cases is the same as would be paid for current for lighting, and the inducement for use is principally the one of convenience. Current for heating purposes can be utilized on a large scale only when a very low rate can be offered and that is often impracticable. Laundries form a very desirable heating load, not requiring any special rates.

Battery charging for vehicle service presents a field which has been cultivated to some extent in certain cities, and which should be diligently followed up everywhere, since it offers a growing and remunerative load, and one which naturally falls to a large extent off the peak. The perfection of mercury-arc and other rectifiers has made such a load available for alternating as well as direct-current systems. Automatic switching devices make it possible for the individual owner to close his charging circuit at night, and know that it will take care of itself without further attention. For the general reputation of the electric vehicle, it is preferable, however, to discourage such use of current in favor of charging in public garages, where trained attendants can see that the batteries receive proper attention. In several of the larger cities the central stations have recognized this fact and have themselves established and operated charging stations, thus insuring that they shall be carried on under competent management. This in turn is greatly enlarging the business. The use of electric vehicles by the station itself will add greatly to the confidence of the purchasing public in their desirability and help to increase this market. It is also well to have a man thoroughly conversant with this subject in the business department, ready to tender advice and suggestions and overcome troubles which may arise in the use of electric vehicles.

There are a number of electrochemical processes offering all-day business, but these frequently require special voltages in direct current and are consequently not easy to serve, though rectifiers could no doubt be applied to such service. Metal refining, electroplating, the manufacture of bleaching solution, etc., come in this category. Other electrochemical processes, not reversible in their nature, can be carried on with alternating current. Among these is the fixation of atmospheric nitrogen for manufacturing fertilizer. While this has already been attempted in this country, prospects are not very bright from the commercial side, unless power can be produced at a lower figure than is usual with central stations. The recent improvements in this art have been mainly on the chemical side, and little is to be hoped for in the line of a market for electrical energy except where hydroelectric development can be carried out at a very low cost.

The manufacture of ozone is a field which has been little worked from either the engineering or business side. The beneficent effects of ozone generation in air for ventilation have been well shown, and it is deserving of wider and larger applications. Data applicable to the manufacture of ozone on a large scale are lacking, but it is quite possible that a considerable field for new business will be found to lie in the application of this process to the ventilation of large buildings, both public and private. A central station might well undertake not only the supply of power for such a purpose, but the management of its operation also. Water purification and other similar applications lie close to hand.

The supply of power for electric furnaces or similar large units is a form of business whose desirability is somewhat questionable. Power in such cases is often desired con-

tinuously, and cannot be kept off the peak. Moreover, changes in load are so large as to seriously affect regulation. The units involved are often sufficiently large to warrant separate supply. The best management of such loads is, as in the case of ice-making, for the central station to itself operate the process. Arrangements can then be made to cease operations during peak load, and to operate at other times upon an independent circuit, utilizing a generator which would otherwise be shut down.

CENTRAL STATION ICE-MAKING.

Elsewhere in this issue will be found several articles dealing with the utilization of central-station plant for the manufacture of ice, a practice that has assumed large proportions, is increasing at a rapid rate and has been found unusually profitable. Indeed, if it came to a close calculation of profits, it might be found that the returns from the ice business, conducted only a portion of the year, would equal, and in some cases exceed, the returns from the electric business, conducted without interruption.

Ice-making will undoubtedly solve the problem of many small and struggling central stations whose summer loads are at present carried with indifferent financial success. Such plants are enabled to make more complete use of their exhaust steam or the surplus power of the station during non-peak periods, applying to double duty a single investment for real estate, buildings and steam apparatus and at the same time utilizing the same office and plant force for both departments of the business. The costs chargeable to each process are thus substantially diminished and margins of profit left which would be impossible in single-utility operation. Ice-making may also render twenty-four-hour operation possible during light-load periods in instances where otherwise it could be conducted only at a loss. So much hinges on the station load-factor that every central-station manager is naturally anxious to acquire a day load, and also to fill in the hollow which follows the night peak. Operating economies then become possible, and with but a slight increase in operating expenses the net income is considerably augmented.

An electric light station, however small, can create a market for its surplus energy by the installation of ice-making machinery. The economies and profit incident to the operation of a combination electric and steam-heating plant are well known. Ice-making does not require extensive underground work and is absolutely under control of the station at all times. According to the conditions of the electric-light load, much or little ice can be manufactured, and during dull lighting seasons and at times of light load, the ice-making plant can be operated at its full capacity and the ice stored until required.

There is a general belief that artificial-ice plants are restricted in geographical distribution by climatic range, or the competition of natural ice. It is true that the profitable value of a combination ice plant is limited by the market for its product, and perhaps in many of the Northern states the demand for ice will not fully tax the by-product capacity of the central station serving the same community with electricity. However, artificial ice is much more sanitary and purer than that naturally frozen, and even where an ice plant is already installed in a town the advantages of economy which the central station enjoys by reason of its combination operation enables it to offer successful competition to the existing industry.

Possibly one reason why the advantages of associating an ice-making plant with the central station have not received wider recognition is that correct engineering principles have not always been applied to such a combination. The owner of a small electric light plant who wishes to put in an ice factory goes to the manufacturer of the ice-making machinery, and the manufacturer hands down one of his standard steam-driven plants such as he would put in if an independent ice factory were to be built. As a result, some of the important economies of operating an ice plant in connection with an electric plant may be deliberately thrown away by such an installation. If the ice plant is to be of the compression type, which is more common, it requires for its operation essentially two things which the electric plant can supply; namely, exhaust steam for condensation to make the necessary distilled water for ice manufacture, and power for driving the compressor. The ice-machine manufacturer is prone to ignore the existence of a large amount of exhaust steam from the electric plant and also to ignore the economy with which power can be produced. Where the absorption process is used, the first cost of which is somewhat greater than for the compression machines, a good-sized ice plant can be operated from the exhaust steam of an electric plant having twenty-four hours' service. In such a case the ice plant simply utilizes the heat which would otherwise be thrown away in exhaust steam.

TAXATION ASSESSMENT AS BASIS FOR DEMAND CHARGE.

A system of adjusting the demand charge in a two-charge rate has been proposed, in which the assessed valuation of the property to be lighted is taken as the basis. The idea underlying this proposal is to use a set of figures which is already available, and avoid the necessity of measuring the cubic contents or wall area of the property illuminated, or of securing other data which might be considered appropriate as the basis for a readiness-to-serve charge. Of course, resort to any such means is only necessary where maximum-demand meters are not in use.

In a particular class of buildings, such as private residences, a criterion of this kind is probably as satisfactory as any other which does not go directly to the root of the

matter and determine the quantity which is directly concerned—the maximum demand during the period of peak load. The size of a building is by no means a measure of its value, since the unit costs are decidedly different in frame, brick, and stone buildings, and vary even more with the style and material of the interior finish and fittings. But in a town where there is not a great variety in the residence construction, especially among that element forming the bulk of the consumers, such an adjustment of demand charges might well prove feasible and satisfactory.

It should be noted in this connection that the assessed valuation of the building is the quantity to be used as proportional to the demand charge. The value of the land upon which the building rests does not enter into the matter, since it has no relation to the quantity of illumination required. In many States, land and improvements are separately assessed and even where this is not required by law it is coming into vogue in connection with the Somers system of evaluation or other rational schemes such as are gradually replacing the archaic method of assigning a lump sum to the entire property. Where, however, the antique style of assessment is still retained, the new proposal could not be so satisfactorily applied.

When apartment buildings, offices, factories, and buildings of other kinds come to be considered, it is at once seen that the proposed method would not be so applicable. In tenements the lighting bills are usually paid by the individual tenants, yet the flats are not separately assessed. However, the total charge could in this case be divided in proportion to the rent, since this is roughly proportional to the size and number of rooms. Buildings other than residences could not, however, fairly be placed upon the same basis of charge as the latter, although among themselves the proportion might be found to be well maintained. The maximum illumination required in office buildings, for instance, may be roughly proportional to their value among themselves, but would not be proportional to that required in a theater or factory. Where current is used for power, it would, of course, be necessary to charge upon a different basis. The scheme seems suited, consequently, only to such towns as have a load somewhat uniform in character, and where a different method, by meter for instance, may be employed in charging for power.

COST OF STREET LIGHTING.

The cost of street lighting has been shown to vary very much from city to city and does not appear to be very uniform even when conditions are apparently very similar. Any data bearing on this subject is always of interest and we wish to call the attention of our readers, therefore, to a table giving statistics and costs which have been collected in thirty-one towns and boroughs in England. This table appears on page 1056. The towns considered range in population from 19,000 to nearly 345,000, and conditions vary from exclusive gas lighting to exclusive electric lighting, the latter in some cases consisting of incandescent and in other cases of arc lights. Costs have been figured upon the basis of a candlepower-year and it is to be noted that in every case in which both methods are employed in the same city, the cost for gas is very much greater than that for electric lighting, amounting on the average to nearly two and one-half times. While the proportionate cost of the two methods varies in the different cases, there is not a single instance where a candlepower-year has not been produced more cheaply by the use of electric current than by the use of the gas lamp. This showing of economy on the part of electric lighting applies equally to the arc and the incandescent lamp, and, as far as can be discovered from the figures here given, there is no great difference in the cost by the two methods of electric lighting. While the specific consumption of an arc lamp is less than that of the incandescent lamp, the trimming, repairs and other attendance bring the total cost per annum to a figure not far from equality.

This compilation of figures from a large number of towns of different size forms a powerful argument in the campaign for the substitution of electric street lighting in places where gas has heretofore been retained. The universality with which the electric method has shown its economy over gas, regardless of the size of the town, or the number of miles of street to be lighted, is an indication that the local conditions have not been responsible for any distortion of the results, but that the same general results can be expected in any new installation.

It should be noted that the individual costs vary excessively. The cost per candlepower per annum for gas ranges from eleven to forty-three cents, or more than 300 per cent. The cost per candlepower per annum for electric light varies from 2.5 to 21 cents, a range of over 800 per cent. These figures show that the conditions in the different towns vary enormously and it is probable that an equal variation would be found in different towns in this country. While such variations exist it is impossible to say what is a fair value for a town of any particular size or working under any particular conditions. The only general result which seems to apply universally is that gas lighting, when considered upon a candlepower basis, is more expensive than electric lighting.

The great variation in the candlepower per mile furnished in the streets of these different communities is worthy of note. This variation is from 1,000 to 12,000 candlepower per mile. The higher figures are found in the larger towns and it is probable that they have been unduly augmented by installations in the business streets which have been put in for business reasons and not purely for general illumination.

Edward L. Nichols.

In the early days of electrical engineering in this country, when consideration was given to the establishment of courses of instruction in our technical schools and colleges, it was quite customary to combine such work and the work of the department of physics. It thus came about that many of the early teachers of electrical subjects were primarily physicists. Among these none is more justly celebrated than Edward L. Nichols, who since 1887 has been professor in Cornell University.

Edward Leamington Nichols was born at Leamington, England, September 14, 1854. His parents, Edward Willard and Maria (Watkinson) Nichols were, however, American, their home being in New York City. The boy was prepared for college at the Peekskill Military Academy and entered Cornell in 1871, where he studied under Prof. W. A. Anthony. After graduation his studies were continued in Germany under Wiedemann, Kirchhoff, Helmholtz and Listing. Under the latter, at Göttingen, the degree of Doctor of Philosophy was conferred and Dr. Nichols returned to America as a fellow at Johns Hopkins University in the laboratory of the late Prof. Henry A. Rowland. He thus had the advantage of early association with the foremost physicists of both Germany and America.

EDWARD L. NICHOLS,
Professor of Physics in Cornell University.

In 1880 Dr. Nichols joined the staff of Thomas A. Edison at Menlo Park, and engaged himself with problems pertaining to incandescent lamps. In 1881 he went to Central University of Kentucky as professor of physics and chemistry, and in 1883 he was called to the University of Kansas as professor of physics and astronomy. When Professor Anthony left the chair at Cornell in 1887, his former pupil was appointed to the vacancy and has since remained the head professor of physics at that institution, where he has carried on a long list of researches in the fields of both electricity and optics. He founded the journal *Physical Review* in 1893, and has since been its editor-in-chief. He was married in 1881 to Ida Preston, of South Dover, N. Y.

Dr. Nichols was among the first to investigate alloys with a low temperature-coefficient of resistance and showed that with certain proportions of the ingredients alloys could even be obtained with a zero or negative coefficient. His later work has dealt with photometry and physiological optics. More recently he has been making extended studies of fluorescence, phosphorescence, luminescence and correlated phenomena. He is the author of many papers on experimental physics which have appeared in scientific journals in Germany, England and this country, and he has published a number of books dealing principally with electrical subjects, including a laboratory manual of physics and applied electricity.

Professor Nichols served as secretary to the Chamber of Delegates of the Electrical Congress at Chicago in 1893, and is a member of the visiting committee officially appointed for the Bureau of Standards. He has the high honor of membership in the National Academy of Sciences and is an honorary member of the National Electric Light Association. He is a fellow of the American Association for the Advancement of Science, and served that body as vice-president for the Physics Section in 1893 and as president in 1907. He was one of the founders of the American Physical Society and was elected president thereof in 1907. He is a member of the American Institute of Electrical Engineers, the American Philosophical Society, and associate fellow of the American Academy of Arts and Sciences, and a member of the Kansas Academy of Sciences, of which he was president in 1885. In 1906 the University of Pennsylvania conferred upon him the honorary degree of LL.D. While Dr. Nichols has done a great deal of work of practical value, he holds fast to the ideal of research for its own sake, contending that the practical applications of fundamental scientific truth can never be foreseen and that valuable applications are often found for the result of researches which have originally seemed to be without practical object. Dr. Nichols may be regarded today as the leader of physical science in America.

Effect of Magnetism on Thermal Conductivity.

It has been known for many years that thermal conductivity was altered by a magnetic field. Some measurements of the effect have been recently made in iron and steel by U. Bordoni and reported in *Il Nuovo Cimento*. A rod of iron or steel sixty centimeters in height was placed within a coil and heated from below while in a vertical position. The temperature range was 12 to 110 degrees centigrade; the maximum magnetization was 1,700 gausses for iron and 1,500 gausses for steel. The magnetization reduced the thermal conductivity by 0.5 per cent in the case of the softest Swedish iron, and by 6.2 per cent in the case of hard Sheffield tool-steel.

National Electric Light Association.

Program of the Annual Convention.

The thirty-fourth convention of the National Electric Light Association will be held in New York City, May 29 to June 2, inclusive. It is expected that there will be a record-breaking attendance, as it is understood that early in the present week the advance registration was considerably over 2,000 and the total membership has passed the 8,300 mark. The complete program of the general, executive, public policy, technical, commercial, accounting, and power transmission sections is given below. This indicates a very busy and serious convention, but the work will be rapidly accomplished, as there will be parallel sessions held in different parts of the splendidly appointed Engineering Societies Building at 29 West Thirty-ninth Street.

Notwithstanding the large volume of work to be accomplished, there will be many diversions, including an evening reception, with a promenade concert, and dance at the Hotel Astor, on Monday evening; a public policy meeting at the New Theater, on Wednesday evening, when addresses will be made by men eminent in public life; a theater party for Thursday evening; visits to the large power plants in the vicinity of New York; and a trip to Coney Island and the Rejuvenation of the Sons of Jove. There will be a baseball game between the team of the Brooklyn Edison Company and the team of the Philadelphia Electric Company, an afternoon tea for the ladies at the Plaza Hotel, concerts at the Waldorf-Astoria, automobile rides to points of interest in the vicinity, and for those who play golf provision has been made at six of the Metropolitan links to which free access and free transportation by train or automobile will be furnished.

PROGRAM.

TUESDAY, 10 A. M., ROOM NO. 1, MAIN AUDITORIUM.

First General Session: President Freeman, Chairman.

Welcome to city.

President's address.

Announcements.

Report of Committee on Membership; H. H. Scott, Doherty Operating Company, New York.

Report of Secretary, T. C. Martin.

Report of Insurance Expert, W. H. Blood, Jr., Stone & Webster Corporation, Boston.

Preliminary Report of Committee on Overhead Line Construction, Farley Osgood, Public Service Corporation, Newark, N. J.

Preliminary Report of Committee on Uniform Accounting, John L. Bailey, Consolidated Gas, Electric Light & Power Company, Baltimore.

Report of Committee on Progress, T. C. Martin.

Paper: "Master and Men," Paul Lüpke, Public Service Corporation, Trenton, N. J.

Presentation of Oil Portrait of Miss Harriet Billings, Assistant Secretary and Treasurer, given by Past-President Henry L. Doherty to the Association, W. C. L. Eglin, Philadelphia Electric Company.

TUESDAY, 2:30 P. M., ROOM NO. 1, MAIN AUDITORIUM.

Second General Session: President Freeman, Chairman.

Report on Bulletin Question Box, M. S. Seelman, Jr., Editor, Brooklyn Edison Company.

Report on Question Box Revision, Paul Lüpke, Public Service Corporation, Trenton, N. J., Alex J. Campbell, New London Gas and Electric Company.

Report of Library Committee: Arthur Williams, New York Edison Company.

Report of Handbook Committee, Arthur Williams, New York Edison Company.

Report of Doherty Gold Medal Committee and Award of Medal, W. C. L. Eglin, Philadelphia Electric Company.

Paper: "Company and Company Section Bulletins," E. A. Edkins, Commonwealth Edison Company, Chicago, Ill.

Topical Discussion on the Work of the Company Sections.

TUESDAY, 2:30 P. M., ROOM NO. 2, FIFTH FLOOR.

First Technical Session: F. M. Tait, Chairman; W. C. L. Eglin, Vice-Chairman.

Report of Meter Committee, G. A. Swain, Public Service Corporation, Newark, N. J.

Report of Committee on Grounding Secondaries, W. H. Blood, Jr., Stone & Webster Corporation, Boston, Mass.

Paper: "Grounding of Low-Tension Circuits as a Protective Measure," P. M. Lincoln, Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

Paper: "Recent Important Improvements in Single-Phase Motors," W. A. Layman, Wagner Electric Manufacturing Company, St. Louis, Mo.

Paper: "Relation of Motor Load to Station Equipment," F. D. Newbury, Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

TUESDAY, 2:30 P. M., ROOM NO. 3, FIFTH FLOOR.

First Accounting Session: John F. Gilchrist, Chairman; John L. Bailey, Vice-Chairman.

Report of Committee on Uniform Accounting, John L. Bailey, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

Paper: "Handling Customers' Orders," R. F. Bonsall, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

Paper: "The Collection of Bills," E. J. Bowers, Kansas City Electric Light Company, Kansas City, Mo.

Paper: "Electric-Vehicle Accounts as Applied to a Department of a Central-Station Plant," Hermann Spoehrer, Union Electric Light & Power Company, St. Louis, Mo.

WEDNESDAY, 10:00 A. M., ROOM NO. 3, FIFTH FLOOR.

Second Accounting Session: F. M. Tait, Chairman; John L. Bailey, Vice-Chairman.

Paper: "Tracing Store Room Material," John T. Brady, Denver Gas & Electric Company, Denver, Colo.

Paper: "The Purchasing Department," T. W. Buxton, Brooklyn Edison Company, Brooklyn, N. Y.

Paper: "Advantages of a Job Cost System," Alec Holme, New York Edison Company, New York.

WEDNESDAY, 10:00 A. M., ROOM NO. 2, FIFTH FLOOR.

Second Technical Session: President Freeman, Chairman; W. C. L. Eglin, Vice-Chairman.

Report: Overhead Line Construction Committee, Farley Osgood, Public Service Corporation, Newark, N. J.

Report of Committee on Preservative Treatment of Poles and Cross Arms, W. K. Vanderpoel, Public Service Corporation, Newark, N. J.

Report of Underground Construction Committee, W. L. Abbott, Commonwealth Edison Company, Chicago.

Paper: "Load Reports of an Electric System," A. S. Loizeaux, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

WEDNESDAY, 10:00 A. M., ROOM NO. 1, MAIN AUDITORIUM.

First Commercial Session: John F. Gilchrist, Chairman; George Williams, Vice-Chairman.

Address of Chairman of Commercial Section, George Williams, Henry L. Doherty & Company, New York.

Report of Committee on Power, E. W. Lloyd, Commonwealth Edison Company, Chicago.

Report of Committee on Electricity in Rural Districts, J. G. Learned, North Shore Electric Company, Chicago.

Report of Committee on Ornamental Street Lighting, W. R. Collier, Georgia Railway & Light Company, Atlanta, Ga.

WEDNESDAY, 12:30 NOON, ROOM NO. 1, MAIN AUDITORIUM.

Executive Session: President Freeman, Chairman.

Action on Report of Public Policy Committee, Arthur Williams, New York Edison Company, New York.

Presentation of Proposed Constitutional Amendments, Frank W. Frueauff, Denver, Colo.

Report of Treasurer, George H. Harries, Potomac Electric Power Company, Washington, D. C.

Election of Nominating Committee.

WEDNESDAY, 8:30 P. M., NEW THEATER.

President Freeman, Chairman.

Public Policy Session:

Musical program will begin at 7:45 p. m., under Director Elliott Schenck, Musical Director of the New Theater.

Presentation of Report of the Public Policy Committee, Past-President Samuel Insull, Commonwealth Edison Company, Chicago.

Address: Hon. Charles Nagel, Secretary United States Department of Commerce and Labor.

THURSDAY, 10:00 A. M., ROOM NO. 2, FIFTH FLOOR.

First Power Transmission Session: John F. Gilchrist, Chairman; J. R. McKee, Vice-Chairman.

Presentation of Report on the April Conference: Water Powers and Their Governmental Control, A. S. McAllister, *Electrical World*, New York.

Paper: "Central-Station Power Plants for Operating Steam Railroads Electrically," Frederick Darlington, Westinghouse Electric & Manufacturing Company, East Pittsburg.

Report of Committee on Protection from

Lightning, B. E. Morrow, Hudson River Electric Power Company, Albany, N. Y.

Executive session.

THURSDAY, 10:00 A. M., ROOM NO. 1, MAIN AUDITORIUM.

Second Commercial Session: F. M. Tait, Chairman; George Williams, Vice-Chairman.

Report of Committee on Electric Vehicles, J. T. Hutchings, Rochester Railway & Light Co., Rochester, N. Y.

Executive Session.

THURSDAY, 10:00 A. M., ROOM NO. 3, FIFTH FLOOR.

Third Accounting Session: President Freeman, Chairman; John L. Bailey, Vice-Chairman.

Paper: "General Office Accounting," Franklin Heydecke, Public Service Corporation, Newark, N. J.

Paper: "Accounting for Depreciation," H. M. Edwards, New York Edison Company, New York.

Paper: "The Extent to Which a Tabulating Machine Can be Used in Accounting Work," Wm. Schmidt, Jr., Consolidated Gas, Electric Light & Power Company, Baltimore.

THURSDAY, 2:30 P. M., ROOM NO. 1, MAIN AUDITORIUM.

Third Commercial Session: President Freeman, Chairman; George Williams, Vice-Chairman.

Report of Committee on Residence Business, Clare N. Stannard, Denver Gas & Electric Company, Denver.

Report of Committee on Electric Heating, Refrigeration and Kindred Appliance Sales, Frank H. Gale, General Electric Company, Schenectady, N. Y.

Report of Committee on Improved Wiring and Equipment Standards, M. C. Rypinski, Westinghouse Electric & Manufacturing Company, New York.

Report of Committee on Industrial Lighting, M. S. Sloan, Birmingham Light & Power Company, Birmingham, Ala.

THURSDAY, 2:30 P. M., ROOM NO. 2, FIFTH FLOOR.

Third Technical Session: John F. Gilchrist, Chairman; W. C. L. Eglin, Vice-Chairman.

Report of the Lamp Committee, W. F. Wells, Brooklyn Edison Company, Brooklyn, N. Y.

Report of the Committee on Prime Movers, I. E. Moultrop, The Edison Electric Illuminating Company, Boston.

Report of the Committee on Electrical Apparatus, L. L. Elden, The Edison Electric Illuminating Company, Boston.

Paper: "Ventilation of Turbo-Generators," R. B. Williamson, Allis-Chalmers Company, Milwaukee, Wis.

Paper: "Progress and Development of Self-Cooled Transformers." M. O. Troy, General Electric Company, Schenectady, N. Y.

FRIDAY, 10:00 A. M., ROOM NO. 2, FIFTH FLOOR.

Second Power Transmission Session: President Freeman, Chairman; J. R. McKee, Vice-Chairman.

Paper: "Increasing the Flexibility and Reducing the Cost of Operation of Steam Boiler Plants by the Use of Fuel Oil," H. A. Wagner, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

Paper: "Determining Cost of Production in Steam Properties under Varying Conditions," George H. Walbridge, Central Colorado Power Company, New York.

Topical Discussion on Operating Transmission Systems.

FRIDAY, 10:00 A. M., ROOM NO. 1, MAIN AUDITORIUM.

Fourth Commercial Session: John F. Gilchrist, Chairman; George Williams, Vice-Chairman.

Report of Committee on Electric Signs, E. L. Callahan, H. M. Byllesby & Company, Chicago.

Report of Committee on Competitive Illuminants, H. J. Gille, Minneapolis General Electric Company, Minneapolis, Minn.

Report of Committee on Advertising, C. W. Lee, C. W. Lee Company, New York, N. Y.

Report of Committee on Functions of a Sales Department, T. I. Jones, Brooklyn Edison Company, Brooklyn, N. Y.

FRIDAY, 2:30 P. M., ROOM NO. 1, MAIN AUDITORIUM.

Third General Session: President Freeman, Chairman.

Report of Committee on Rate Research, John F. Gilchrist, Commonwealth Edison Company, Chicago.

Paper: "Elements Affecting the Fair Valuation of Plant and Property," W. F. Wells, Brooklyn Edison Company, Brooklyn, N. Y.

Paper: "Some Reasons for Difference in Price for Different Services," N. T. Wilcox, Lowell Electric Light Corporation, Lowell, Mass.

Paper: "The Standardization of Electrical Selling," Douglass Burnett, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

Paper: "Economies in Operation Possible Through Time Study," L. B. Webster, Marion Light & Heating Company, Marion, Ind.

Report of Committee on Memorials, T. C. Martin.

Report of Committee on Form of Section Organization, Frank W. Frueauff, Denver Gas & Electric Company, Denver.

Vote on Constitutional Amendments.

Report of Nominating Committee.

Election of Officers.

Adjournment.

Chicago Subway Hearings Begun.

The first public hearing on the plans for an extensive subway system for Chicago was held on May 22 at the call of the Committee on Local Transportation of the City Council. Bion J. Arnold, chief subway engineer for the city, was given the privilege of presenting his plans first. He took up the entire first session in explaining his latest plans and answering questions respecting them.

Mr. Arnold has made three reports on the subway problem to the city, the first in 1902, then one in 1906, and the most complete one on January 31, 1911. The last one was referred to in these columns in the issue of February 4. Mr. Arnold has slightly modified the order of the steps for his recommended plan. He is now in favor of beginning with a four-track subway in State Street to be built in open cut at a total cost of about $8,000,000. This would permit through routing north and south surface and elevated cars. Then two deep-level subway loops would be built for the two West Side elevated-railway systems at a cost of about $13,000,000. The two rebuilt river tunnels and the La Salle Street tunnel now being built would not be connected to the subway system for a few years. The subway would gradually be extended and all the construction undertaken directly by the city, without financial aid from any of the transportation companies. Space would be provided for piping and ducts of public utilities.

Other plans will be submitted to the committee by City Engineer Ericson, George W. Jackson, R. C. St. John, the Chicago Subway, Arcade & Traction Company, the Chicago Central Subrailroad Company, the Chicago Municipal Subway Company, and the M. H. McGovern Company.

Resume Negotiations for Merger of Chicago Elevated Roads.

Negotiations for the long proposed merging of the four elevated railroad systems and the union elevated loop in Chicago have been again resumed, this time on a more definite and hopeful basis than heretofore. Henry A. Blair has completed arrangements to finance the undertaking and has submitted proposals to the boards of directors of the five companies for an outright purchase of their capital stock for cash or partly in cash and partly in securities of the consolidated company. The acceptance of these proposals by two of the companies is still somewhat conjectural. The total mileage of the elevated systems is 177 miles. The proposed capitalization is about $43,000,000. The Chicago municipal authorties, while heartily in favor of the proposed merger, announce that they will insist on through routing and universal transfers.

Transcontinental Telephony Proposed.

As an outcome of the successful opening on May 8 of long-distance telephone communication between New York City and Denver, a distance of 2,011 miles, it is already being proposed to connect Denver and San Francisco by means of loaded telephone lines so as to permit talking across the entire continent, a distance of about 3,000 miles. In view of the fact that about 1,000 miles was the practical limit for telephone purposes prior to the New York-Denver service, and that this limit has now been suddenly doubled, it seems plausible to believe that a fifty per cent further increase may be achieved in a few years.

American Mining Convention.

The time of holding the fourteenth annual convention of the American Mining Congress, which will be in Chicago, Ill., has been fixed for October 23 to 28.

Echoes From the Supply Jobbers' Del Monte Meeting.

What was beyond any doubt the most successful excursion and meeting held by the supply men and jobbers of this country was that taken by the National Electrical Jobbers' Association from April 18 to April 24. The list of those in attendance and the chronicle of the departure of the special train from Chicago for the West was published in a recent issue of this journal.

The success of the entertainment features of the trip was due largely to the efforts of H. H. Cudmore, chairman of the entertainment committee. In this work Mr. Cudmore was assisted by L. W. Kittman, C. C. Sibley, T. C. Ringgold, and Robert Kuhn. Song books were distributed and the singing festivals were a delightful feature of the entertainment. In addition to this there were card games galore, and the daily perusal of the "Daily Shock," the very creditable newspaper distributed enroute. A stop was made at the Grand Canyon of Colorado on April 21, when the entire day was spent at the canyon. Here an excellent entertainment was provided, the graceful feature being the dancing of Miss Cotabish.

The party arrived in California on April 22, and were royally entertained by the open-hearted and generous Western electrical men. Until the departure of most of those in attendance on April 24, they were busily engaged in participating in the hospitality extended by their Western friends.

During the California sojourn there were a number of events, the trophies and winners being as follows:

Trap shooting, tankard, won by A. E. Drendell.

Approaching and putting contest, cup, donated by Shreve & Company, E. M. Demming.

Runner up, Jobbers' first flight, cup, C. C. Sibley.

Manufacturers' qualifying round, goblet, donated by Hotel Del Monte, R. J. Davis.

Best score Jobbers' qualifying round, goblet, donated by Hotel Del Monte, R. D. Holabird.

First men's tennis tournament, military brushes, H. I. Sackett.

Runner up, Manufacturers' first flight, cup, T. E. Bibbins.

Winner Manufacturers' first flight, goblet, W. J. Grady.

Winner Jobbers' second flight, goblet, donated by T. E. Bibbins, C. P. Hill.

Winner Jobbers' third flight, cup, Charles White (H. V. Carter tied).

Woman's putting contest, cologne bottle, donated by T. E. Bibbins, Mrs. E. W. Rockafellow.

Men's approaching and putting contest, flask, donated by T. E. Bibbins, E. M. Demming.

First woman's tennis tournament, candy jar, Miss K. Carter.

Winner Manufacturers' third flight, goblet, E. K. Patton.

Second men's tennis tournament, silver deposit bottle, G. R. Jones.

Winner Jobbers' first flight, cup, donated by T. E. Bibbins, Fred Fullerton.

Second woman's tennis tournament, bridge-whist set, Mrs. H. G. Aylsworth.

First pool tournament, cup, W. T. McCullough.

Second pool tournament, silver deposit bottle, W. S. Berry.

Winner Manufacturers' second flight, cup, B. M. Downs.

Men's driving contest, tankard, donated by Andrew Carrigan, H. E. Sanderson.

One of the enjoyable features of the meeting was the souvenir program beautifully printed and illustrated in gold and colors, which was presented to the visiting electrical men by our esteemed contemporary, the *Journal of Electricity, Power and Gas.*

Minneapolis Electric Show Plans.

Activities have already been started on the Minneapolis Electric Show for 1912, which will be held in the Armory, Minneapolis, March 16 to 23. It is the aim of the Northwestern Show Association to make the coming third annual show the most successful so far held and with this in view the Board of Directors decided on dates when a number of engineering bodies will meet in Minneapolis, thus giving greater impetus to the affair. Among the engineering bodies meeting during the course of the show are: the Minnesota Electrical Association, Minnesota Section American Institute of Electrical Engineers, State Electrical Contrators' Association and the Minnesota Telephone Association.

Robert W. Clark, of the Minneapolis General Electric Company, has again been chosen to head the management of the show.

Conduit in Railway Work.

A brief paper bearing this caption was presented by J. Andreucetti, of the Chicago & Northwestern Railroad, at the May meeting of the Car Lighting Club, held in Chicago, May 17. The paper treats of the development of electric wiring, both interior and exterior, and points out the relation of metal conduit to this development. The various brands of conduit on the market were classified and the advantages and disadvantages of each touched upon. The conditions imposed on metal conduit used in car-lighting work were briefly mentioned, Mr. Andreucetti stating that unusually hard and lasting material was necessary, owing to the severe service encountered.

Following the reading of this paper, the representatives of the various brands of metal conduit present were each given an opportunity to explain the merits of their conduit. Those participating in the discussion were F. R. Bryant, representing the American Conduit Manufacturing Company; O. L. Richards, representing the Safety Armorite Conduit Company; V. A. Swet, representing the Sprague Electric Company; Mr. Webb, representing the American Circular Loom Company, and George W. Cravens, of the Delta-Star Electric Company.

In this discussion the process of manufacturing the various conduits was explained and it was brought out that practical tests made on conduit under actual working conditions were of more value than analytical or theoretical tests. It was also the consensus of opinion that the protecting material used on metal conduit was secondary in importance to the composition of the metal itself.

The meeting was then given over to a general discussion of various questions pertaining to railway electrical work.

Municipal Electricians to Convene at St. Paul.

The annual convention of the International Association of Municipal Electricians will be held at St. Paul, Minn., September 12 to 15, inclusive. Arrangements are being made for an exceptionally interesting program of papers interspersed with entertainment features. Clarence R. George, of Houston, Texas, is secretary of the association, and the president is H. C. Bundy. The headquarters of the association will be at the Ryan Hotel.

The Electric-Vehicle Situation in Milwaukee.

BY GEORGE J. KIRCHGASSER.

Up to December, 1910, there were only 194 electric vehicles in the city of Milwaukee. There are now 225 and possibly by the latter part of the summer the number may reach 250. But this is a rather poor showing for a city having a population of almost 400,000. At present there is only one electric truck in use in the city, the balance of the 225 being pleasure vehicles, the Woods, Rauch & Lang, and Detroit predominating. Compared with Detroit, Cleveland, Buffalo and other eastern cities, Milwaukee is somewhat behind in this line.

There are a number of reasons for this condition of affairs. Up to the latter part of 1907 the electric-vehicle manufacturers had not established agencies in Milwaukee, and the Milwaukee Electric Railway & Light Company has, until recently, given very little help; in fact, the Company, previously, according to several vehicle men, actually retarded progress by asking excessive rates for charging vehicles. One of the first garages had to pay eight cents per kilowatt-hour for all current used. No efforts were made to encourage the use of electric vehicles. The streets of Milwaukee have not been the best and this may have had a slight effect on restricting the use of electrics also. However, there are now many beautiful boulevards and paved streets which should be a rather stimulating factor in the use of electric automobiles.

At the present time, of the 225 electrics, between fifty and fifty-five are charged in private garages, all by means of rectifiers, except three or four which are supplied with direct current. Under the Milwaukee Electric Company's new rate schedule a single meter will be used to measure the current for lighting and battery charging in a residence and private garage. A primary charge of twelve cents per kilowatt-hour is made for (1) the first four kilowatt-hours consumed per month for each of the first four active rooms; (2) the first two and one-half kilowatt-hours consumed per month for each of the active rooms in addition to the first four; (3) to this is added a secondary charge of five cents per kilowatt-hour for all energy in excess of that paid for at the primary rate up to a total of 100 kilowatt-hours and four cents per kilowatt-hour for the next 900 kilowatt-hours used.

The method of figuring a bill for a house, for instance, that had six active rooms, would, according to this system, be as follows: four kilowatt-hours for each of the first four rooms and two and one-half kilowatt-hours for each of the additional two rooms, making twenty-one kilowatt-hours, at the twelve-cent rate. All current in excess of this up to 100 kilowatt-hours, or in this case seventy-nine kilowatt-hours at the five-cent rate and four cents for the next 900 kilowatt-hours used. The rate therefore for the current used for charging batteries is five or four cents per kilowatt-hour (in the private garage).

In this kind of service, of course, there are no limitations as to time of charging, but the customer is urged not to charge between 4 and 7 o'clock p. m. The rate obtained under this

FIG. 1.—INTERIOR OF KOPMEIER ELECTRIC-VEHICLE GARAGE, MILWAUKEE, WIS.

new schedule should help to encourage charging in private garages and have a good effect generally on the electric-vehicle situation.

There are at present six public garages in the city, three of which use central-station current. Of these three, the Estberg garage located on Jackson Street near the downtown district is the largest. Gasoline automobiles are also garaged here, the establishment being the largest of its kind in the state of Wisconsin. Current is received from the 220-110-volt Edison system and because of the large amount of current used and the limited or "off-peak" service the rate per kilowatt-hour approximates three cents.

The rate to customers signing the standard form of contract, providing for service for a year or more, is based, first, on a demand charge, and second, on an energy charge. The demand charge, which is payable in equal monthly payments, is $42 per year for each kilowatt of demand for the first ten kilowatts; $30 for the next fifty kilowatts, and $24 for each kilowatt of demand in excess of sixty. The energy charge is five cents per kilowatt-hour for the first 100 kilowatt-hours per month consumption; four cents for the next 900 kilowatt-hours; three cents for the next 3,000 kilowatt-hours; two cents for the next 6,000 kilowatt-hours, and 1.2 cents per kilowatt-hour for all energy consumed in any month in excess of 10,000 kilowatt-hours. As no lamp renewals are received at Estberg's these rates are reduced one-half cent per kilowatt-hour.

The Estberg Garage is on the limited or "off-peak" service and a reduction of one-half the demand charge is made, on condition that the service shall not be used during a specified time of the day from October to March. In each month the end of this period is 7:00 p. m., the beginning being for the six months respectively: 5:30, 5:00, 4:30, 4:40, 5:20 and 6:00 p. m.

There is also a "ten-seven" service, which applies to customers utilizing the Company's service only during the hours from 10:00 p. m. to the following morning at 7:00 a. m. For this service only one-quarter of the demand charge is made. Mr. Estberg cannot make use of this "ten-seven" rate, as he would have to put in more charging equipment (increasing the kilowatt demand) to enable him to charge all of the vehicles in the shorter period. This increased equipment would make his demand charge greater. Also in a public garage this limited period is impracticable as it is often necessary to charge some batteries during the day.

At this garage open-wire type rheostats are used, one placed at each charging plug. No central meter board is employed, the men judging the conditions of charge and batteries by listening for gassing. Mr. Estberg claims his men must continually watch the batteries being charged, frequently feeling the batteries to note temperature rise and not depending on meters to know when the charge is complete.

No Edison cell vehicles will be charged at this garage, as special equipment would be needed because of the heavy charging current required. Also special rates would have to be made, as the rate of $30 per month, which is the charge for other pleasure vehicles, is altogether too low for Edison automobile batteries.

The Kopmeier Garage, which is located in the center of the East Side residence section on Summitt Avenue, is about the same size as Estberg's. Between 55 and 60 electrics are garaged here, the equipment and methods employed both being up-to-date. Figs. 1 and 2 show the interior of this garage. A well equipped machine shop and gasoline-automobile garage are also parts of this establishment.

The current for charging, lighting and power is generated on the premises at 110 volts, direct current by a gas-engine-driven dynamo. A producer-gas plant furnishes the gas, the company considering this more economical than buying gas or electricity from the local public service companies.

Besides the generator and meter panels there are twelve charging panels of the "slider type." Each panel has three rheostats, the resistance used being of the grid type, mounted directly on the back of the panel as shown in Fig. 3.

FIG. 2.—KOPMEIER GARAGE SHOWING CHARGING PANELS.

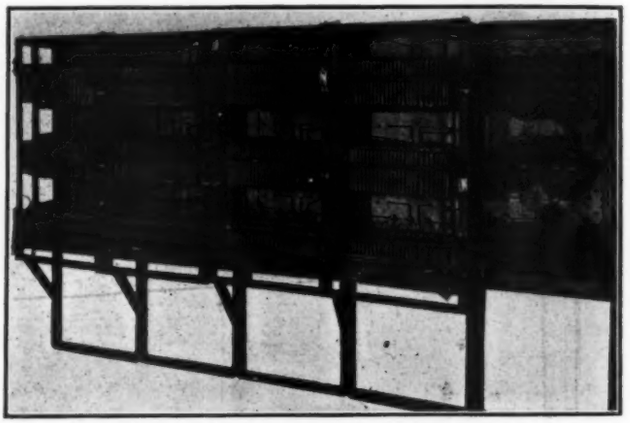


FIG. 3.—REAR VIEW OF "SLIDER TYPE" CHARGING PANELS.

Records as to mileage conditions of batteries, etc., of each vehicle are kept. No regular periods are set for washing out the batteries, such washing being done when the condition of the cells, as revealed by inspection, makes it advisable. Sometimes the mileage runs up to 6,000 before washing is necessary, depending upon the batteries and the way in which they are used.

The Belleview Garage, shown in Fig. 4, is located in the upper East Side residence section of Milwaukee and shows the evidences of a well-managed charging station. The usual number of electric pleasure vehicles boarded here varies between 16 and 20. The current is generated on the premises by means of a gas-engine-driven 110-volt dynamo rated at eighteen kilowatts. Mr. Mo-

cross, the proprietor, finds that because his consumption of current is not very large that his rate for central-station current would be about 5.5 or 6.0 cents. He therefore buys gas from the city gas company and claims that even after this transformation his cost is considerably less.

The number of miles each vehicle has traveled during the day is recorded and when only a small part of the charge has been used the batteries are not charged. All cells are frequently inspected and washed out when required.

At this garage twelve vehicles can be charged at one time. There are six individual charging rheostats and a "slider-type" charging panel, which handles the other six charging plugs.

The Welsh garage is located in the downtown district and is run in conjunction with an electric and gasoline-automobile salesroom. Only about ten or a dozen cars are garaged here. Current is purchased from the Milwaukee Electric Railway & Light Company, the service being from the 220-110-volt Edison three-wire underground system.

Another garage of this size is located in the residence section of the West Side on Twentieth Street near Grand Avenue. Central-station current is used, a motor-generator set providing the direct current. Six charging plugs are provided and a "slider-type" charging panel is used similar to the one employed at the Belleview and Kopmeier garages. Gasoline automobiles are also boarded here.

In the center of the best residence section of the West Side (Twenty-seventh and State Streets) another gasoline-automobile garage has just installed a charging panel. This equipment consists of six rheostats, the operation being by means of pivoted levers. Six vehicles can be charged at once and as this garage has just started in this business only six vehicles are at present boarded. Central-station current is not purchased but current is generated by a 110-volt direct-current dynamo directly connected to a four-cylinder automobile gasoline engine.

The rate at all except one of the charging statious per month is $30, which includes charging, cleaning, adjusting, etc., and one delivery and one call per day. A gasoline-garage man located in the West Side residence section is contemplating opening an electric-automobile station in conjunction with his gasoline garage and if he can convince his customers to place ampere-hour meters in their cars he will charge them only for the current used per month plus a boarding charge. The reason for this is that it seems unfair to charge the man who uses his automobile only from 50 to 150 miles a week the same as one who runs 40 to 50 miles per day. By means of the ampere-hour meter an accurate record could be kept of the current consumed in charging the batteries.

Before the new sales organization of the Milwaukee Electric Railway & Light Company can do much in the way of helping the electric-vehicle situation it intends to replace the three gasoline trucks that it now uses by electrics. When this is done plans will be made to get new business in this line as the new men in charge realize the possibilities in this direction. The present owners of electric automobiles are well pleased and it is therefore certain, with better rates, more agencies and help from the electric company, that Milwaukee will soon have a greatly increased number of electrically driven machines.

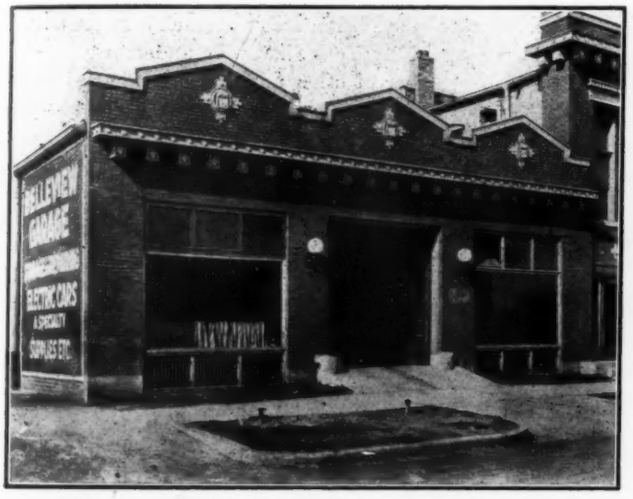


FIG. 4.—BELLEVIEW GARAGE, MILWAUKEE, WIS.

FIG. 5.—DUPLICATE SETS OF CHARGING PANELS IN KOPMEIER GARAGE.

Some Features of the Panama Canal.

Various interesting features of the Panama Canal were presented by Thomas I. Stacey in an address before the Chicago Electric Club on May 17. While the address was non-electrical, Mr. Stacey brought out a number of points regarding the work in the canal zone that are of general engineering interest.

Mr. Stacey spoke of the work that had been accomplished by the French company before the acquisition of the property by the United States. He gave figures of cost and by means of maps and charts explained the geographical and climatic conditions obtaining in the Canal Zone. The various features of the project were then illustrated and described in a very interesting manner.

Some idea can be gained of the enormity of the work being done when it is learned that the Culebra cut which is nine miles long, is costing $10,000,000 per mile to complete. The canal will save a voyage of 10,000 miles to steamers voyaging from the Atlantic to the Pacific or *vice versa*. It will take a ship twelve hours to pass through the canal, whereas thirty days would be required to sail around Cape Horn. Mr. Stacey stated that electric locomotives will be used for towing ships through the locks in the canal.

The Commercial Section of the National Electric Light Association.

For many years the most important discussions undertaken by the National Electric Light Association have had to do with the technical engineering problems which appertain to the generation and transmission of electrical energy. Power plant design, organization of operating forces, operating economy and similar details, have taken up the major portion of the attention of those in attendance upon the convention. Since the Denver convention of 1905, however, more and more attention has been paid to the commercial side of the business and the contract agent and new-business manager have come in for a very necessary share in the discussion of the problems involved in the whole central station effort. So rapidly has the idea of establishing a new-business department developed and so many have been the topics that have come up for discussion that the natural outcome has been the development and organization of a section devoted exclusively to the commercial side of central station work. One of the originators of the commercial section idea and one of the leading spirits in the organization of the Commercial Section, is George Williams. As a result of his activity a meeting was called during the St. Louis convention a year ago, with about 150 commercial men in attendance. This resulted in the appointment of an organization committee, with George Williams as chairman and Frank B. Rae, Jr., as secretary. Mr. Williams' nomination and election were unanimous. After the St. Louis meeting there were several discussions among individual members of the organization committee with the result that the present scheme of organization which has been accepted by the National Electric Light Association was drafted by Mr. Rae. The organization committee has held a number of general meetings and a large number of committee meetings during the year, and the excellent program which is offered by the Commercial Section for the present convention is the result of their strenuous labors.

The Commercial Section has been formed to foster closer co-operation among the commercial men of the central-station industry and among those manufacturers, jobbers, dealers and contractors who are interested in central-station commercial development. Through the activities of the various committees of the Commercial Section much valuable new-business data is being gathered and assorted. This data, covering every phase of central-station commercialism, will be published for the exclusive use of members of this section. The committees are made up of specialists and experts on the subjects which they are severally investigating, and they stand as an advisory counsel, ready and equipped to assist all members of the section in handling any commercial problems.

George Williams, chairman of the Commercial Section, came from Canada to the United States sixteen years ago, and after a brief period of em-

T. I. JONES,
Chairman, Committee on Functions of a Sales Force.

ployment in Cleveland, Ohio, in other lines, drifted into the fixture and gas appliance business, moving to Chicago, and later to Pueblo, Colo., where he sold gas appliances on commission. When Henry L. Doherty was organizing the new business department of the Denver Gas & Electric Company, Mr. Williams was one of the first men to be appointed on the staff, and in a very short time more than made good. Shortly after this appointment, Mr. Williams was sent to Madison, Wis., by the Doherty interests to establish a commercial department there, and his success in that city has been followed by others more remarkable in a number of other localities. Mr. Williams is now commercial manager in general charge of all the properties embraced by the Doherty interests.

Frank B. Rae, Jr., secretary of the section, was born in San Francisco thirty-one years ago. His father, who is well known as an electrical engineer in every part of the country, was especially prominent during the early days of the electrical industry and must be credited with much of the pioneer and really valuable work undertaken in the pioneer days of electric street railways. Frank B., Jr., was a special student at the University of Chicago, where he was editor of the *University of Chicago Weekly*. Among his early literary experiences was a connection with the Roycrofters at East Aurora, where he did a great deal of original and rather extraordinary work. Leaving the Hubbard institution he became advertising counsel for Street & Finney, with large financial interests in New York City. He undertook a number of other advertising and sales management commissions, including several electrical accounts. When J. Robert Crouse inaugurated the Cooperative Electrical Development Association propaganda, Mr. Rae participated in the conferences of Mr. Crouse and his associates and coming prominently to the attention of several companies handling electrical accounts he finally became connected with the Lee Company, Newark, N. J., holding the position of secretary until February, 1908. Later on Mr. Rae established our esteemed contemporary, *Selling Electricity*, and also established the Rae Company for the handling of corporation publicity of every character. Mr. Rae has won the confidence of a host of big people in the electrical industry and possesses to a rare degree a dual capacity as a strong copy writer and business getter.

T. I. Jones, chairman of the committee on functions of a sales force, is general sales agent of the Edison Illuminating Company of Brooklyn. In this position he has full charge of the selling end of the company's business, including all contracts for electric light, heat and power, the company's advertising, engineering work, appliance bureau and installation work. He graduated as an electrical engineer from the Massachusetts Institute of Technology in 1896, when he began work in the New York office of the American Telephone & Telegraph Company, being in the identification, inspection and traffic departments. He originated and equipped the

first school of instructions for telephone traffic. This has since become an important adjunct of all telephone companies' work. Four years later he took charge of the traffic department of the New York & New Jersey Telephone Company, and while thus employed he delivered a course of lectures on telephone and electric-light topics before the New York Board of Education. This work Mr. Jones continues at the present time. In the early part of 1907, Mr. Jones accepted a position as illuminating engineer with the Nernst Lamp Company, in New York, later becoming manager of the sales department of the United Electric Light & Power Company, of New York. His work here was so successful that he was invited to take charge of the commercial end of the Brooklyn Edison Company and this position he has held for about two years. The year 1910, the first full year of Mr. Jones' supervision of this sales department, the Brooklyn Edison Company broke all its previous records as to total output and gross income, and the year 1911 thus far is exceeding similar months in 1910.

J. T. Hutchings, chairman of the committee on electric vehicles, is general manager of the Rochester Railway & Light Company, Rochester, N. Y., and has contributed greatly to the success of the Rochester organization through the enterprising and energetic campaign instituted through his new business department. He has particularly engaged in the development of an extensive garage business and the electric vehicle equipment handled in Rochester is indeed a matter of pride in that community.

Frank C. Rypinski, chairman of the committee on improved wiring and equipment standards, has been actively identified with the electrical measuring-instrument field since 1902. He was born at Giddings, Tex., November 8, 1877, and graduated as an electrical engineer in 1897 from the Rose Polytechnic Institute at Terre Haute. From 1897 to 1902 he was in the standardizing laboratories and engineering departments of the General Electric Company at Schenectady, specializing on electrical instruments. From 1902 to 1904 he was superintendent of the Empire Electrical Instrument Company, of New York City, and from 1904 to 1906, was president of the Simplex Electric Company, of Newark, N. J. Since 1906 he has been connected with the Westinghouse Electric & Manufacturing Company, first in the engineering department at East Pittsburgh and later in the New York sales office. At the present time he is manager of the detail and supply departments in that city. He has taken out a number of patents

M. C. RYPINSKI,
Chairman, Committee on Improved Wiring and Equipment Standards.

and completed a number of engineering designs, and his committee bids fair to be a most important element in the Commercial Section.

Errett L. Callahan, chairman of the committee on sign lighting, has been conspicuous in the development of commercial methods in central stations. He is manager of the new business depart-

E. L. CALLAHAN,
Chairman, Committee on Sign Lighting.

ment of H. M. Byllesby & Company, Chicago, which has in charge the management of upwards of thirty-five electric properties and twenty gas properties, serving eighty-three separate municipalities in the West and South. Mr. Callahan was born at Scio, N. Y., May 19, 1876. While a boy he passed several years on South Dakota and Kansas farms, returning east to Cleveland, Ohio, when fifteen years old. He attended the Hiram College, at Hiram, Ohio, following an academic course. After a four years' course in the Case School of Applied Science he graduated in 1900 with the degree of Bachelor of Science. Mr. Callahan worked his way through Case by the designing and construction of laboratory apparatus, in the electrical engineering department, operating the dynamos of the lighting plant, and machine-shop employment. During vacations he followed similar occupations. In 1903, he received the Electrical Engineering degree from Case School. After leaving college Mr. Callahan was commissioned as an electrical expert in the signal service of the War Department, being assigned to the equipment with automatic telegraph instruments of a proposed submarine cable from Nome to St. Michaels, Alaska. Returning from this expedition, he was engaged for two years in the experimental laboratories of the Crehore-Squier Intelligence Transmission, at Tarrytown, N. Y., later joining the forces of the Postal Telegraph Company, carrying on experiments in automatic telegraphy between New York and Chicago. Early in 1902, he entered the service of Westinghouse, Church, Kerr & Company, where he was associated with a number of important installations. For some time Mr. Callahan had been interested in the possibilities of electricity for heating, and in 1902 he became assistant manager of the Simplex Electric Heating Company, of Boston. Three years later he went to New York City as assistant engineer, later becoming manager of the Prometheus Electric Company. In 1906, he became connected with the General Electric Company, as manager of the heating department of the Chicago District office. His work here was very important in building up this department, and by 1909, the salesmen-demonstrators working out of the Chicago office heating department had increased to fourteen members. When the commercial departments of the various electric and gas companies operated by the Byllesby Company were reorganized in 1909, Mr. Callahan was selected for this task. His work here has been eminently successful and the men employed in the new business departments of the local properties now number close to 100.

M. S. Sloan, chairman of the com-

mittee on industrial lighting, is assistant to the president of the Birmingham Light & Power Company, Birmingham, Ala. From 1903 to 1906 he was with the General Electric Company in the testing department and on the road as construction engineer. On July 1, 1906, he became assistant superintendent of the lighting and power departments of the Birmingham Company. On September 6, 1907, he was made superintendent of power, becoming superintendent of the business department on July 7, 1908. On December 22, 1909, he was made superintendent of the lighting department and on January 27, 1910, was appointed to his present position.

E. W. Lloyd, chairman of the committee on power, has for nineteen years been connected with the Edison interests in Chicago, Ill. As general contract

M. S. SLOAN,
Chairman, Committee on Industrial Lighting.

agent of the Commonwealth Edison Company Mr. Lloyd has been actively engaged in building up one of the most remarkable central-station loads in this country. The territory supplied by the Commonwealth Edison Company and the diverse nature of the load is such as to have called for remarkable ability both in organization and in the direction of the numerous departments of the contract office. Mr. Lloyd has contributed a number of classical papers on the subjects of getting new business and of methods of making and applying rates for charging for electrical energy.

John G. Learned, chairman of the committee on electricity in rural districts, was born in Chicago about thirty-two years ago. His first connection with the electrical industry was with the Chicago Telephone Company, and for the last five years he has been connected with the contract department of the Commonwealth Edison Company. While working as a solicitor in the new business department of the old Commonwealth Electric Company he went through the Chicago Law School, taking the evening course and being admitted to the bar in 1902. On April 1,

JOHN G. LEARNED,
Chairman, Committee on Electricity in Rural Districts.

1905, he was appointed general contract agent for the North Shore Electric Company. While the contract department was small at first, this territory, covering 1,200 square miles, has proved a rich field for cultivation and in this position Mr. Learned has achieved a great success. He was the first secretary of the North Shore Electric Com-

C. N. STANNARD,
Chairman, Committee on Residence Business.

pany branch of the National Electric Light Association.

Clare N. Stannard, chairman of the committee on residence business, entered the electrical industry in the employ of the Binghampton Gas & Electric Company in 1890, taking a complete gas and electrical engineering cadet course, covering a period of four years, after which he was made superintendent of distribution for the company, remaining in this position for a number of years. Going to Denver he entered the employ of the Denver Consolidated Electric Company, and in 1898, on the consolidation of the gas and electric interests in Denver, he was made superintendent of distribution for the new company. He entered the commercial department of the Denver Gas & Electric Company in 1901, and later on was made secretary and commercial manager, the position he now occupies. The Denver Gas & Electric Company may be considered as one of the earliest organizations to adopt the present-day methods of educating the public to an appreciation of the benefits of the electrical service and under Mr. Stannard's aggressive management the com-

F. H. GALE,
Chairman, Committee on Heating, Refrigerating and Kindred Appliances.

pany is going on to still greater achievements.

F. H. Gale, chairman of the committee on heating, refrigeration and kindred appliance sales, is manager of the advertising department of the General Electric Company. Mr. Gale is one of the best-known men in the electrical manufacturing and supply fields and by his personal efforts has done more than any other single individual to make the great expositions held in conjunction with the National Electric Light Association and by the many State organizations a matter of profound satisfaction to the industry at large. His work as chairman of this important committee will prove a source of strength to the entire Commercial Section.

C. W. Lee, chairman of the committee on advertising, has for many years been identified with the advertising and publicity end of the public utility field.

For a number of years he was in control of the telephone department in Ohio with the Central Union Telephone Company, afterwards becoming identified with the Butte Electric Company, at Butte, Mont. He went East to engage in newspaper work and in this capacity served on the great dailies in Detroit, Chicago and New York. In 1904 he created the advertising department for the Public Service Corporation of New Jersey. In 1905 he organized the C. W. Lee Company, publicists and commercial engineers for public utility companies, and since that time has been its active head.

J. Robert Crouse, chairman of the committee on membership, is a graduate of Michigan University of the class of 1893. After his graduation he was actively engaged with the Fostoria In-

C. W. LEE,
Chairman, Committee on Advertising.

candescent Lamp Company and the Fostoria Glass Specialty Company, of Fostoria, Ohio. Since the formation of the National Electric Lamp Association he has been active in general office work in an advisory capacity. He was chairman of the commercial-program committee of the National Electric Light Association in 1906, 1907 and 1908, and was chairman of the general membership committee in 1908. Mr. Crouse has been more than actively identified with the central-station industry and the phenomenal interest given to the matter of spreading the gospel of more light and advertising its advantages through the Co-operative Electrical Development Association is entirely due to his efforts. His interest in the Commercial Section of the National Electric Light Association is truly catholic and his donation of a beautiful silver loving cup to be competed for by members of the Commercial Section for securing new members has greatly stimulated the effort being made to swell the ranks of the Section.

William Rawson Collier, chairman of the committee on street lighting, is contract agent and manager of the meter and lamp departments of the Georgia

J. ROBERT CROUSE,
Chairman, Committee on Membership.

Railway & Electric Company, of Atlanta, Georgia. Mr. Collier was born in Atlanta, on July 3, 1878. After studying in private schools in Atlanta he studied for four years at Charlottesville, Va., and graduated in the electrical course from the Massachusetts Institute of Technology with the class of 1900. Leaving college, with S. P. Brown, of New York, he acted as con-

W. R. COLLIER,
Chairman, Committee on Street Lighting.

sulting engineer with offices in Atlanta under the name of Collier & Brown. In 1905 the firm was dissolved, Mr. Collier entering the employ of the Georgia Railway & Electric Company in the engineering department. After being with this company for two years he became associated with the Electric Manufacturing & Equipment Company, organized in Atlanta for the manufacture of special electrical apparatus. After a year's work with this company he again decided to take up central-station work and returned to the Georgia Company. Mr. Collier's work has been in a rapidly developing field and the enterprise shown by his company has redounded not only to the benefit of that particular community, but has helped the whole central-station proposition in that part of the country.

H. J. Gille, chairman of the committee on competitive illuminants, was born in Washington County, Minn., May 19, 1870. He was educated in the public schools in Washington County, and Curtiss College, completing the course in June, 1889. He immediately entered the employment of the Columbia Electric Company, and in 1891 he

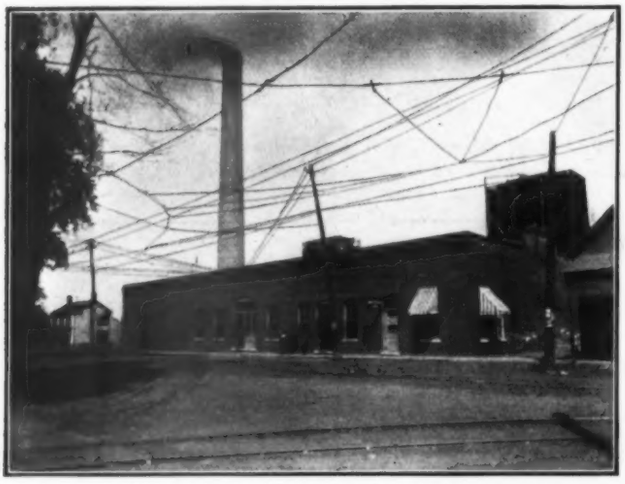
H. J. GILLE,
Chairman, Committee on Competitive Illuminants.

became associated as assistant and later as purchasing agent with the Northwestern Thomson-Houston Electric Company. In 1894 he became assistant manager of the supply department of the Chicago office of the General Electric Company, and in 1895 became electrical engineer of the Washburn & Moen Manufacturing Company. In 1898 he became manager of the electrical department of the St. Paul Gas Light Company and the Edison Light & Power Company. He was general superintendent from 1901 to 1907, and since June, 1907, has been commercial agent of the Minneapolis General Electric Company. Mr. Gille has been a valued member of a number of committees dealing with the subjects connected with the commercial departments of central-station companies and his papers on these topics are a valuable addition to the literature on this subject.

COMBINATION ICE, ELECTRIC AND STEAM-HEATING PLANT.

SUCCESSFUL OPERATION OF THE VIRDEN ELECTRIC COMPANY'S PROPERTY.

The economies and profits incident to the operation of a combination electric and steam-heating station are quite generally known. Although their total number is almost twice as great, combination electric and ice-making plants have not been taken so seriously. The significance of this field, however, is now being more fully realized by central-station men and it is safe to predict that ice making will solve the problem of many small and struggling central stations whose summer loads are at present carried with indifferent financial success.



VIRDEN ELECTRIC LIGHT PLANT—CONDENSERS SHOWN ON ROOF.

PORTION OF BOILER ROOM, VIRDEN PLANT.

The combination of these two auxiliaries—steam heating and ice making—by an electricity supply corporation is indeed an ideal condition, and in this connection attention is called to the central station at Virden, Ill., the Virden Electric Light Company.

Virden, Ill., is a progressive town of about 4,000 inhabitants, located about midway Chicago and St. Louis, on the main line of the Chicago & Alton and the St. Louis-Springfield division of the Illinois Traction System.

The Virden Electric Company's station is admirably situated for supplying steam heat to the business portion of the city and a large percentage of the stores and business buildings are connected to the lines of the company. Climatic conditions in Virden are such that the steam heating and ice business follow one another without interruption, the ice business being started immediately upon the close of the heating season. The generating capacity of the electric station is 240 kilowatts and there are connected on the company's lines about fifty city arc lamps, seventy-two private arc lamps, 2,000 incandescent lamps and about twenty horsepower in motors.

The Virden station is a modern one-story brick and concrete building 120 feet long and seventy feet wide, and the layout of the building and the general arrangements of the various machinery and apparatus make for the most economical operation.

The north end of the station, housing the steam-generating equipment, is adjacent to a spur railroad track on which the coal is received at the plant. Coal is shoveled from the cars into the boiler directly in front of the boilers. The boiler room is thirty-eight feet wide and seventy feet long and is divided in the center with a passageway leading to the engine room. The boiler equipment comprises two ninety-horsepower Atlas water-tube boilers, on the left of the passageway, and one 250-horsepower O'Brien water-tube boiler on the right. All three boilers are hand fired.

One of the features of the Virden plant is the highly ornamented Alphons Custodis smokestack. This stack is 100 feet high and is about eight and one-half feet in diameter. By reason of the height of the stack forced draft for the boilers is not necessary.

In the passageway, leading from the boiler room to the engine room, are located the pumps and feed-water heater. The boilers are supplied with water by one seven-by-five-by-ten-inch and one six-by-four-by-six-inch duplex pump, of the Fairbanks-Morse type, interconnected so that either can supply one or all three boilers. The feed-water heater is of the Cochrane type.

The engine room is separated from the pump room by a fire-brick wall. The generating equipment comprises one 150-kilowatt and one ninety-kilowatt Fort Wayne alternator belt connected to an Atlas and an Ideal Corliss engine respectively. The machines generate single-phase, sixty-cycle current at 1,150 volts, which is stepped down to 110 volts for local distribution. Each generator has its individual exciter, placed near the cylinder of the engine and belt driven from the main wheel of the engine, this arrangement being economical of space. The ninety-kilowatt unit is now used to take care of the day load, which it was estimated would never be large, there being little opportunity for a large motor load.

The switchboard is of blue Vermont marble consisting of five panels; two of these with the usual complement of instruments are for the control of the two generators and three are for the feeders.

Installed in a separate room 18 feet by 20 feet in size, adjoining the engine room, is the ice-making machinery which has a rated capacity of ten tons of ice, twenty-ton refrigerating, in twenty-four hours, cold storage not considered. The plant is of the steam-driven ammonia-compression type, the compressor being driven by a direct-connected Corliss-valve engine. The ice plant is of the York Manufacturing Company's make. The freezing plant is adjacent to the engine room on a

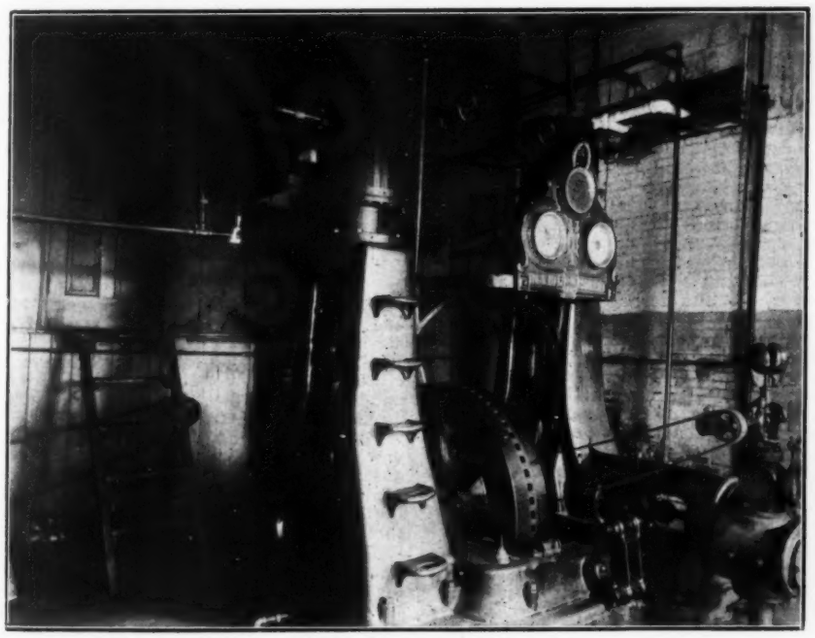
level about six feet above the engine-room floor level. The room has a capacity for 156 300-pound cans; and the time of freezing is forty-eight hours.

The storage room has a capacity of ninety-five tons of ice, which has been found ample. The can-dump floor of the storage room and the loading platform are on the same level so that the lifting of the ice is reduced to a minimum.

MAIN ENGINE ROOM.

The cans are handled by a hand-operated crane.

Each section of the freezing tank discharges its warm brine into a common receptacle from which the circulating pump draws its supply. The ammonia condenser and brine cooler are of the standard double-pipe type.



ICE-MACHINE ROOM.

The exhaust steam of the entire plant, during the summer months, passes through the feed-water heater which is also equipped with an oil separator, and thence to the condensing coils, which are located on the roof of the building. The distilled water thus obtained, after reboiling to expel the air, is filtered and then passes to the supply tank where it is partially cooled by the brine returning from the refrigerating tank.

The water supply for the plant is obtained from a running creek, fed by tile from a large drainage district, so that abundant water of fine quality is available. It is piped 1.5 miles to the plant through a three-inch pipe line, and is pumped by a ten-horsepower motor. There is also a compressed-air pumping outfit. A concrete dam situated across the creek can be closed when necessary.

As already noted, the Virden Electric Company also supplies steam heat. Exhaust steam from the engines is used for this and only on rare occasions, when the weather is very severe, is it found necessary to by-pass live steam into the heating mains.

The combination of the steam-heating and ice equipment enables the steam production, boiler, fuel, and labor expenses to be reduced and shared between the three departments. The ice plant provides a steam load for the boilers during the slack season and the resulting operation is thoroughly satisfactory from both the executive and operating standpoints.

The Virden Electric Company sells its ice wholesale to a local dealer at an unusually low figure. Unfortunately figures are not available for publication showing the cost price of the manufacture of ice by this plant; but it is said to be sufficiently low to be attractive.

The plant is a credit to the city of Virden, and in fact, would be a credit to a much larger city. It is not only a credit but a great benefit to the city and enables the citizens to have day current, steam heat and home-manufactured ice, all of which are unusual in cities the size of Virden.

Water-Power Plant for Canada.

The Canadian Government recently gave a hearing to a plan for an immense water-power project to be built at Cedar Rapids on the St. Lawrence River. The plan includes gigantic water chutes over the Cotean and Cedar Rapids, which are about twenty-five miles north of Montreal. The plan, it is said, will develop 500,000 horsepower, ultimately, and will cost $20,000,000.

EDISON MEDAL PRESENTED TO F. J. SPRAGUE.

ADDRESSES AT ANNUAL MEETING OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The annual meeting of the American Institute of Electrical Engineers was held on May 16 in New York City. The results of the election of officers were given in our last issue, the directors' ticket, headed by Gano Dunn, being successful. The proposed amendments to the constitution were defeated, as they lacked the necessary three-fourths vote.

The secretary presented the annual report of the Board of Directors. This reviewed the work of the year by the Board and by the various Institute committees. The present membership of the Institute was stated to be 7,117, a net increase of 436. The financial statement showed a cash balance of $29,990, and an expenditure during the year amounting to $11.03 per member.

The president called upon Elihu Thomson, chairman of the Edison Medal Committee, and first recipient of the medal, to present the report of that committee. The remarks of Dr. Thomson follow:

In 1904, following upon the celebration in honor of Mr. Edison, and of the twenty-fifth anniversary of the invention of the incandescent lamp, the Edison Medal Association was organized by a number of his friends and admirers, who established the Edison Medal to be given to those distinguished for electric achievements, and the selection of the recipient was delegated to a committee of this institute.

Acting for this committee, and in accordance with its by-laws, I now have the pleasure of announcing its recommendation that the Edison Medal Award be granted to our worthy fellow member, Mr. Frank J. Sprague.

I need not now dwell upon the invaluable pioneer work in electric railways, nor upon the original inventions in multiple-unit control, as exemplified in urban and interurban electric railways, performed by Mr. Sprague. His work in vertical transportation by high-speed elevators is a fitting complement to so much achievement in horizontal traction. The *Transactions* of the Institute have been enriched by many valuable papers and discussions on these and kindred topics, in which Mr. Sprague has been the leading figure, and although it is nearly thirty years since he began work in his chosen field of electric-motor applications, he is still to the fore in the later problems of transportation by electric power, a branch of electrical engineering, the future of which will doubtless far outrival the brilliant past. But Mr. Sprague entered the field when the art was new and untried, when the burdens were heavy and the toil unceasing, when history had to be made by strenuous effort in the face of great difficulties. His merit is that he has succeeded.

It is a gratification to the Edison Medal Committee to assist in the suitable recognition of this work of Mr. Sprague by its recommendation of the Edison Medal Award to him. I have now the honor, Mr. President, of leaving to the Institute to carry to completion on this occasion the work of this committee, by the presentation of the certificate of award and the accompanying medal.

President Jackson then made an address, in which he said in part:

The Edison Medal, founded in commemoration of the twenty-fifth anniversary of the successful introduction and commercial development of the electric incandescent lamp, was established by the friends, associates and admirers of that great creative genius and inventor, Thomas Alva Edison, on his fifty-seventh birthday, February 11, 1904. A deed of gift places the design in the custody of the American Institute of Electrical Engineers as a trust, with the provision that out of the proceeds of a trust fund shall be provided not oftener than once a year a gold medal, to be conferred in recognition of achievement of highest merit in electricity. The medal is to be called the Edison Medal, and to be executed in gold. The medal is conferred by the deliberation and choice of a committee of twenty-four members, nearly two-thirds of whom are appointed for terms of five years by successive presidents of the Institute, and the others are officers of the Institute or are elected by the board of directors from its own membership for two-year terms.

The name of Edison is one of the few that range alongside of the names of Watt and Stephenson among the makers of the world's fundamental industries. Edison's mind is the development of that type characteristic of the ablest engineers—wax to receive impressions of the important phenomena about him, but marble to usefully retain them. The designation of the medal as the "Edison Medal" is, therefore, significant of marked accomplishment; and the medal itself, of noble metal, modeled by James Earle Fraser, is worthy of this high place. The American Institute of Electrical Engineers has a distinguished duty to perform in guarding the high standard of this medal for the interest and appropriation of the profession.

The institute has thus far performed its true duty. One medal has been heretofore conferred, the medal of 1910; and this was conferred on Elihu Thomson—gentleman, scholar, scientist and profound inventor of electrical machines. The medal of 1911 is now to be conferred on Frank Julian Sprague. A pledge that the reputation of succeeding years is well guarded lies in the personnel of the board of directors of the Institute and the personnel of the Edison Medal Committee.

The parent flower of electrical engineering was unfolded by Galvani and Volta at the closing of the eighteenth century. Its seeds were fertilized and sown by Humphrey Davy, Hans Christian Oersted, Michael Faraday and Joseph Henry, during the first third of the nineteenth century. Although watched, tended and nurtured by many men, the new vine showed little commercial vigor or usefulness to the world until the last third of the nineteenth century, when, with the electric telegraph already established, the multicoil dynamo armature, the telephone, duplex and quadruplex telegraphy, commercial arc lighting, the incandescent lamp, the electric railway, all sprang into being. Sparks of all sciences were fanned into flame and made to contribute to the growth, and electrical engineering became a marvel amongst the world's industries.

In the meantime the growth of the cities of civilized nations brought an awakening demand for improved urban and interurban transportation. Scientists and inventors responded to the stimulus, and, amongst other transportation projects we may observe the early electric railway experiments of Siemens and of Edison. Transportation and intercommunication comprise the breath of life of modern civilization, besides dominating a great part of the world's industry. Improved urban and interurban transportation obviously then is primary in the welfare of the cities, and in that part of the national life which depends on the cities, and it is not surprising to find active-minded inventors, attracted by the fascinations of the electric power, attempting to apply it as a motive power for transportation purposes.

When Sprague invaded Richmond in 1887, resolutely plunging into a pool of difficulties from which only unceasing fertility of invention and tireless industry could extricate him, he woke the world of transportation to an acknowledgment that the electric railway, though an infant, had a future. Sprague's restless nature contrasts with the more cautious processes of the able Van Depoele, his rival in the commercial development of electric traction in America; but we now forget the financial difficulties of the Richmond experiment in contemplating the brilliancy of the manoeuver, and rejoicing in the world-wide effect of its success.

Sprague's courage and persistence are proverbial. Give to others all due credit in the development of the electric railway as a useful agent, and we must still admit that Sprague's courageous, persistent, resistless preaching and practice had a primary influence in bringing about the conditions and producing the inventions which afford our modern, rapid, cleanly and cheap electric suburban transportation service by tramway.

The problem of the electric elevator attracted Sprague, and he went with dash into the business of building master-controlled electric elevators. This led indirectly to another important invention in electric traction. Laying, in his mind, several master-controlled electric elevators on the level, he invented the multiple-unit control for electric trains; and he introduced the invention in commercial service by means demanding a courage that commands admiration from even the deepest doubter of the commercial wisdom of the spectacular process. I have heard Sprague modestly speak of the multiple-unit invention as no more than a simple arrangement of devices, and, in fact, it is that, but simplicity in apparatus is a natural offspring of brilliancy in conception. It is not necessary for me to more than mention the undeniable importance of the multiple-unit control. It has made rapid transit by subways in great cities a practical mode of transportation, and has greatly improved the character of elevated railway and suburban train service. By these characteristics, it, like its predecessor, the electric tramway, has improved and sweetened the life of the average dweller in the great cities.

It seems that an engineer who creates new industries or profoundly influences old ones, needs to possess some of the same kind of inspiration that moved Martin Luther, Erasmus or Wesley. Something of this may be seen in the Richmond electric railway work of 1887 and in the Crystal Palace tests of 1882, the conception of the multiple-unit control. It is manifest that Sprague's life has been infected with the spirit of inquiry and the joy of accomplishment.

On the grounds of his electric-motor inventions and his traction accomplishments, I am authorized to confer on Mr. Sprague the second Edison Medal conferred in the history of its foundation.

President Jackson then presented the medal, which bears upon its obverse a

portrait of Thomas A. Edison, and on its reverse an allegorical conception, "The Genius of Electricity Crowned by Fame."

In accepting the medal, Frank J. Sprague said in part:

I would indeed be strangely constituted if I were not deeply sensitive to, and profoundly moved by, so kindly an introduction, so cordial a reception, and so great an honor as the award to me of the Edison Medal.

In truth, I am glad to be thus honored, and to pretend otherwise would be to violate one of the essential tenets of our profession, which above all teaches us to be exact in statement; and thank you all, I do, with a very full heart. I am not, however, unmindful of a first-hand knowledge of my own shortcomings, and I know how unwarranted it would be to assume that this compliment is limited to a personal recognition of the work which as an engineer it has come to my hand to do, and the possibilities of which are so largely a matter of professional training, rightness of the times and existence of opportunities.

The committee, it is true, has been good enough to individualize me in this happy manner, but what would have been the result if in addition to a special training, the material and personal health and the loyal support vital at critical times had not been forthcoming? Rarely is there an industrial development on any large scale except by the combined effort of many people. One may by nature be more aggressive and optimistic, more persistent and confident than some of his fellows—may, if you please, be called a master workman, but he must have his living tools, his faithful co-workers, and some measure of financial help.

I would, therefore, be indeed remiss if I did not thank you not alone for myself, but also first on behalf of my beloved *alma mater*, the United States Naval Academy.

I thank you, too, for those who in business and professional ways, in sunshine and in storm, when discouragements crowded thick and fast as well as when hopes ran high, were an ever present help—Johnson and Harding, McPherson, Crosby and Greene, Lundy, Mason, and O'Shaughnessey, Carichoff, Hill and Sheppard, and a host of others.

Of two of these I can only think and speak with deep feeling and especial affection. They, too, were trained in our National schools and graduated with high honors—Crosby from West Point and Greene from Annapolis. Each resigned a commission which was the stepping stone to high rank, influence and possible fame, and cast their lot with a struggling inventor and abbreviated fortune in a new art and an undeveloped field. All through the days of Richmond, often dark ones, and during my absence on account of a critical illness, one in New York and the other on the ground, with flag unfurled and steady helm, they fought against heavy odds the battle of the early trolley.

I was once asked the somewhat difficult question just what I considered my particular status and work and what was my mental process in what the questioner termed invention; to which in candor I had to reply that I was simply a constructive engineer with enough of inventive faculty or imaginative equipment to form a basis for activities, and an immature financial sense sufficient to entangle myself and my friends in industrial development; I might have added, enough of self assurance to be willing to venture a long way in support of any conclusion arrived at, and with a love and capacity for work. As to mental processes, they are those of an engineer who seeks a solution of problems as they arise. This is all neither very individual, nor does it spell genius, but I am content that it is so.

That chance largely determines one's activities and one's success or failure in life is beyond question, and in this connection the Edison medal has especial significance to me because of early associations. Perhaps under the circumstances I may be permitted to make brief reference to these.

My cadet life in Annapolis covered the period when Bell, Gray, Farmer and Edison were rousing the imagination of the scientific world, and incidentally something of the knowledge of their endeavors penetrated the circumscribed surroundings of naval routine and aroused in me a spirit of restlessness.

Later, when I was fortunate to get orders for the first electrical exhibition at Sydenham, England, in 1881-2, and was serving there as a juror, I became so thoroughly impressed with the soundness of Mr. Edison's work in the development of his electric lighting system, and the possibilities of electric railway and power development, that after making my formal report to the Navy Department and recommending the general use of electricity in the service, I accepted the opportunity to resign and to enter the employ of Mr. Edison as his assistant. It was during this period, while riding on the Metropolitan underground railway of London, that my conception of an electric trolley system first took definite form—the fixed lamps between the two networks of a fixed difference of potential in the Edison system being replaced by the moving trains, and the networks themselves by the tracks on which the trains moved, and a system of conductors following the center lines of all tracks and switches, and with which a contact was to be made by an upward-pressure device carried on the car.

It is the fortune of but a few to be, like Edison, inventors in the highest sense of the word, and perhaps not many more for whom training, inclination, opportunity and fortuitous circumstances combine to give the privilege of blazing the path of new industries. But in any event, one can be glad to be a member of that profession which above all others forms the advance guard of civilization, typifies the restless creative energy of our age, and which is of necessity imbued with the romantic spirit of adventure. It has been said by some prosaic individual that it is the best engineer who can make a dollar earn the highest dividend, but while it is true that in the end a reasonable commercial return is the necessary incentive and accompaniment of engineering advance, a really great engineer must be something of a prophet, one gifted with second sight, and with a power not only to visualize his conceptions, but also to execute them.

A story was told to illustrate the difference between a lawyer and an engineer. The former is destructively inquisitive and the latter inquisitively constructive. The engineer is trained not only to ask questions and find weaknesses, but to correct them; to build up, not to pull down; to create, not to destroy. His training is along the lines of exactness; and honesty in investigation and conclusion, in designing and construction, constitute the very foundation of his professional ethics. There is no room for high finance or crooked practice in the determination of strengths of material, centrifugal or centripetal forces, or the factors of safety. Moreover, the engineer is a necessity because he is the connecting link between conception and realization—between capital and dividend. If he is an inventor as well, he must be a sane one, not a visionary.

It is my own belief, founded on considerable experience, that most inventions of importance are rarely inspirations, but are the simple, practical solutions of engineering problems which are presented to us in the natural course of events, and may derive their importance because of collateral circumstances. They are, also, often supplemental to, or the logical result of, other inventions which have preceded them.

Sometimes one wonders if any other period will match the past half century as an epoch of extraordinary development, with its inventions of potential possibilities, its creation of new industries, its galaxy of illustrious names. Some of the latter by universal consent occupy positions of unique pre-eminence rightly assigned in the perspective of history for their contributions to science. But it would be a rash man who would put a limit on what is to come. Who, for example, will find the secret of the firefly and duplicate its light efficiency? Who will harness the energy of the sun, or corral the restless tides? Who will make two blades of grass grow where one now is, and will solve the problems of eternal waste? Who will restore our forests, refill our mines, and drive our coalless ships? Who must conserve our fast diminishing natural resources?

In our profession, there are new paths to blaze, fresh histories to make, unending worlds to conquer. The heritage of greatest value which we can leave to those who bear our names, will be that of high aims realized, and creative work well done; and the Edison Medal whose award is the occasion of our assembling here tonight, will prove a constant and effective incentive, and its attainment the worthy object of any man's honorable ambition.

The remainder of the meeting was devoted to a number of addresses dealing with electric railways, and one upon the use of electricity in the navy, for which Mr. Sprague was educated and in which he became an officer. The first address was by William B. Potter, on

DEVELOPMENT OF THE ELECTRIC RAILWAY.

Mr. Potter interestingly reviewed the work of such men as Volta, Faraday, Galvani, Ampere, Ohm, Henry, etc., pointing out how their work contributed to the general advancement of electrical science. The commercial development of electric railways, although fostered by early experiments, had to wait for the development of the electric generator and the first electric railway resembles the modern type in that it received its energy from an electric generator installed by Siemens, at the Berlin Exposition in the year 1879. From this date the progress of the art was continuous and effective. Mr. Potter gives credit to the work of Edison, Field, Siemens, Van Depoole and Sprague, commenting on the contributions each made to the industry. The first application of the electric railway to public service was made by Siemens at Litcherfeld, Germany, in 1881. The work which led more especially to the commercial development of the electric railway in this country began in 1883, when an electric locomotive was built by Field and Eickemeyer and exhibited at the Chicago Railway Exposition. During the same year Daft and Van Derpoele began their experiments, and in 1884 the Sprague Company was formed. In 1887 Sprague secured the contract for the electrical equipment of the Union Passenger Station, Richmond, Va., and the road was opened for traffic in 1888. Considerable progress was made by others during this and succeeding years, notably by Bently and Knight, the Thomson-Houston Company and the Edison General Electric Company. Some idea of the tremendous growth in America can be gathered from the fact that while in 1888 there were but 172 electrically propelled cars on 86 miles of road, in 1899 there were

over 41,000 electric cars operating on upwards of 14,500 miles of road. The paper concludes with a biographical sketch of Frank J. Sprague, pointing out how his work influenced the electric railway industry and many of his inventions are today being employed on the principal systems in the country.

The next address was upon "Social Results of the Introduction of the Electric Railway" by Franklin H. Giddings, professor of sociology in Columbia University.

SOCIAL RESULTS OF THE INTRODUCTION OF THE ELECTRIC RAILWAY.

Following the lines of development of the electric railway, Mr. Giddings stated that he had found that within the past ten years the capital put into electric railways had increased over fifty per cent, that the number of passengers carried had increased by over 136 per cent, and the number of employees had increased by ninety-eight per cent, and that the trackage had increased by 177 per cent. This increase has not had the effect predicted—of destroying trade in smaller towns. It has increased business in small places as well as in cities. Moreover, it enables people to live in city or country as their tastes dictate and still be easily in touch with nearby places. "I think," he added, "that any fair and reasonable survey of the facts will convince a judicious mind that the total effect of this change in means of communication is in the long run not to increase concentration, not to bring into existence some new, peculiar class of human beings, not to present some new and peculiarly economical studies, but is on the whole, so far, to equalize and level, as to secure a very great predominance of this middle class of excellent averages, which is the stability of American life, without that impossible standardization, that impossible bringing up everything to a common level, which is destructive of all originality, of all variation from the type, of all invention, of all breaking away to go on into new and unexpected things in the future. In this I see the real advantage, the real social effect, of the introduction of the electric railway."

"The Relation of Government Control to the Development of Electric Railways and Electrification of Steam Lines" was next discussed in an address by George F. Swain, professor of civil engineering in Harvard University.

GOVERNMENT CONTROL AND ELECTRIC RAILWAYS.

Dr. Swain introduced his address by referring to the three important steps in the application of electricity to transportation: first, development of electric propulsion of street cars; second, development of multiple-unit operation of trains; third, electrification of steam railroads. With both the former Mr. Sprague had taken a leading part. The third step has more serious financial than engineering difficulties to overcome. It is a more complicated and far-reaching problem than that involved in the first two steps. Electrification of a railroad naturally starts at some important terminal or tunnel, where it does not result in such great economy as it does when extended to eliminate an entire engine run.

This is an age of government supervision, particularly of public utilities. This supervision should be limited to requiring reasonable service, reasonable safety to employees and public, and reasonable charges for service without unfair discriminations. All other features should be left uncontrolled to the individual initiative of the public-utility managers. This should be the policy respecting transportation companies. Dr. Swain cites six reasons for governmental non-interference with the electrification of steam railroads:

(1) Despite all of its well-known advantages, electrification is not a necessity, but a luxury. (2) Railroads have been hampered financially by excessive governmental interference and hostile public prejudice and would have difficulty in raising the capital required for compulsory electrification. (3) Terminal electrification would delay the electrifying of an entire section and therefore not produce the economies of the latter. (4) Compulsory electrification would deter the railroads from making experiments which might result in more economical and improved service. (5) Terminal electrification would probably result in an installation not well adapted to the electrification of a long stretch of the line. (6) Electrification has not yet been sufficiently standardized.

The last paper of the evening was on "Electricity in the Navy" by Commander S. S. Robison.

ELECTRICITY IN THE NAVY.

In his introductory remarks Mr. Robison noted a coincidence, in that the first dynamo built for the Navy was received in Annapolis in 1874, the same year in which Frank J. Sprague entered the Naval Academy as a midshipman. The machine was known as a magneto-electric machine and was constructed by Prof. M. G. Farmer with the object of ascertaining its usefulness aboard ship for signaling purposes, searching for torpedoes and preventing collision or surprises. About the same time the study of electricity was taken up in the Navy torpedo school, the course taking up the investigation of the various types of firing batteries, leading wires, splices and connections, which would stand immersion in salt water. In a short time the study of searchlights was taken up in connection with the use of the searchlight to cover mine fields. After demonstration an installation of a searchlight for practical usefulness was made on the *Hartford* in 1878. The first electrically controlled searchlight was brought out in 1881. In 1883 work started on the installation of electric lights on the *Trenton*, this ship being the first man-of-war so lighted. The equipment comprised one engine and one dynamo, complete, to supply energy to 238 lamps having a total candlepower of 3,092. The total cost of this plant, including installation, was $5,500, which figure was contrasted with $600,000, the cost of the electrical installation of the battleship *New York*, which is just being completed.

The paper points out details of the first installation, recounting the troubles that had to be dealt with and giving interesting operating data. In 1885 four steel ships were equipped with the incandescent electric lighting system and the office of Naval Inspector of Electrical Appliances was created. The paper then deals with the development of electric motors and their application to naval service, pointing out particularly the work of Sprague in this connection. The next development in electricity in the Navy was the result of the experiments of Marconi, in wireless telegraphy in 1895, 1896 and 1897. The Navy Department commenced investigation of this subject which was continued until 1903, by which time arrangements had been perfected for supplying most of the larger vessels with wireless equipments. The paper concludes with a description of the electrical equipment on the United States Battleship *New York*.

A High-Tension Electrostatic Wattmeter.

At a recent meeting of the Physical Society of London, a paper describing a high-tension electrostatic wattmeter was read by E. Wilson. When using the electrometer as a wattmeter, the author said it was necessary in order to secure accuracy that the voltage impressed upon the quadrants should not be less than a certain minimum, depending upon the voltage to be impressed upon the moving system. When the latter voltage was of the order of 10,000 volts the quadrants required a voltage larger than could economically be provided by a shunt. One was led, therefore, to consider intensifying devices. The current transformer, whose secondary winding was closed on a non-inductive resistance, could be used to give fairly good results, but it was not accurate at all frequencies, and was dependent upon wave form. The quadrature transformer designed by the author was a very simple piece of apparatus which could be relied upon to give for electrostatic wattmeters an electromotive force which was strictly the differential of the current in the primary winding. When so used it was necessary, for accuracy at all frequencies and on all wave forms, that the integral voltage should be impressed upon the moving system, although for sine curves only the differential need be impressed instead of the integral. The best device to impress on the quadrants a suitable voltage in phase with the currents was a generator with an air-cored magnetic circuit, which the author described. The current was passed through the field coil of the generator, and produced a magnetic field proportional to the current; the armature was driven at known speed in this field, and was provided with a commutator and brushes. The brushes, when set accurately, had a voltage between them proportional to and having the same wave form as the current.

Large Hydroelectric Project Proposed.

Announcement has recently been made that the Great Western Power Company, of California, will build at Big Meadows a reservoir that will surpass in capacity the Roosevelt Dam and Reservoir in Arizona. Sufficient water will be stored for the irrigation of 300,000 acres. Electric energy will be generated.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

CENTRAL-STATION ICE PLANTS.

BY J. F. NISBET.

Ice-making as a side line for central stations is not a new idea, but it is only within comparatively recent times that any prominence has been given to this subject. A little consideration will readily show that an ice-making plant, as an adjunct to a central station, possesses features which enable the two plants to be run on a more economical basis than would be possible with either plant running singly.

A single investment for real estate, buildings and steam-power plant is all that is necessary for both departments. In many instances it is possible to house the ice-making plant under the same roof with the electrical department, and to utilize the services of the same engineers and firemen. By these means considerable reductions can be made in the operating expenses, and a greater margin of profit left, than would ever be possible with either plant running singly.

Ice-making is also an excellent means for utilizing the surplus power of the generating station, and for filling up the valley in the load curve during the non-peak periods.

It has been ascertained that there are at least 260 or 270 combination ice-electric plants at present in operation, and presumably operating at a good profit. These facts should be sufficient indication that a combination plant is a paying proposition, indeed it could hardly be otherwise, providing a ready market can be obtained for the ice.

The greatest demand for ice occurs during the summer months at a time when the central station is operating with the lightest loads and it has been conclusively proved in many instances that the auxiliary ice-making plant has been the means of converting the heretofore unproductive summer months into the most profitable period of the year.

The location of the central station naturally determines to some extent the productive period of the ice-making plant. In some of the southern states ice-making is continuous for 365 days in the year, while in plants situater further north, this period drops in some instances to three or four months. It is not surprising therefore to find the majority of these combination plants located in the South, Texas with its large and rapidly developing area heading the list with a total of 84.

Ice-making and refrigerating plants can be classified under two distinct headings:

(1) Compression plants in which the gas is drawn from the expansion side of the plant by the action of a compressor, then compressed to a liquifying pressure, and finally discharged into the condenser.

(2) Absorption plants, which absorb the gas from the expansion side into water, the weak liquor so formed being heated in a still, and the gas driven out of the water and forced into the condenser.

Of these two systems the first is more generally in use, chiefly owing to the fact that it can be operated under a greater variety of conditions. Most of the central-station plants with ice-making auxiliary equipment are operating on the ammonia-compression system, possibly due to the fact that a plant of this description can be located independently of the boiler equipment and is more flexible in many ways.

It is somewhat difficult to accurately estimate the kilowatt-hours required to produce a ton of ice. This figure will naturally vary in different stations, local conditions being largely responsible for the variations. Investigations which have been made, however, fix this figure at somewhere between 50 and 60 kilowatt-hours for plants working on the compression system.

The majority of the combination plants already in existence are located in the smaller towns, at least seventy per cent being located in towns with a population of 5,000 or under.

The power required to drive an ice-making plant will vary from 2.8 to three horsepower per ton of ice in the larger plants, to four horsepower per ton of ice in the smaller plants.

The horsepower required to drive an ammonia compressor when the back pressure and condensing pressures are known can be determined by aid of Table I.

TABLE 1. MEAN EFFECTIVE PRESSURE.

Back Pressure.	Condenser Pressure.					
	150	160	170	180	190	200
5	51	52	54	56	58	60
10	56	58	60	62	64	66
15	62	64	66	68	70	72
20	65	67	69	72	74	76
25	67	69	72	76	78	80
30	68	71	74	78	80	83
40	69	73	76	80	82	86

It is necessary to multiply the area of the piston in inches by the mean effective pressure found in above table; then multiply by the speed of the piston in feet per minute and divide by 33,000. This gives the horsepower required.

To this result, twenty per cent should be added to take care of friction losses in the machines.

For example, the horsepower required to drive an ammonia compressor having a double-acting compression cylinder 10 inches in diameter by 18 inches stroke, running at 80 revolutions per minute, with 20 pounds back pressure and 180 pounds condensing pressure would be as follows:

Area of cylinder 10-inch diameter= 78.54, therefore $78.54 \times 240 \times 72/33{,}000 = 41.15$ horsepower. Increasing this by twenty per cent gives 49.3 horsepower required to drive the compressor.

The success of an ice plant depends to a large extent upon the quality of ice. Not so many years ago, the common idea was that "Ice was ice"; whether clear or cloudy, pure or contaminated was not seriously considered by the consumer. The product from the neighboring pond found ready sale, regardless of the fact that before freezing over this may have been practically the dumping ground of the vicinity.

Circumstances, however, in the form

of increased competition, health agitation and the education of the consumer have banished this condition of affairs. Ice to be salable now must not only be clear and transparent in appearance, but must be chemically free from impurities. Consequently the construction of the distilling apparatus has gradually become one of the most important factors in determining the success of an ice-making plant.

That method of distilling water known as the "Gravity system" is shown in the accompanying illustration.

In this, water after being condensed in the steam condenser, passes by gravity through the reboiler, flat cooler, charcoal filters and storage tanks and finally into the ice cans. Whenever it is impracticable to use the gravity system, the condensed water can be taken into a distilled-water pump. This pump in turn transfers the water to the reboiler from which it passes on its way without further mechanical handling.

What may be called the "keystone" of successful distilling apparatus is the steam condenser. Here the final quality of ice is determined. After the steam is freed from all traces of oil, it enters the steam condenser, there being several types of apparatus used for this purpose, the most improved designs being the pipe or shell types. From the condenser, the condensed water passes to the reboiler at the highest possible temperature. Here the water is reboiled by means of a coil supplied with live steam, which allows the accumulated solids and foreign liquid matter to collect and drain off. The water is then carried into the flat cooler shown in the foregoing illustration and reduced in temperature. In moderate-sized plants reboilers are usually of the circular type, while larger plants have usually a rectangular reboiler.

The distilled water from the reboiler enters the cooler at the top and flows downward, while the water for cooling enters the cooler at the bottom and flows upward, thereby cooling the outgoing distilled water to practically the same temperature as that of the incoming cooling water. This type of cooler is known as the double-pipe flat cooler, and is most generally employed since its use rather encourages cleanliness about the plant. Another type is known as the "atmospheric type" but is not in such general use. From the cooler the distilled water passes on to the charcoal filters.

The charcoal filters are usually made from galvanized steel with a compartment for the retention of charcoal. This may be removed from time to time for cleansing. From the filters the water moves into the storage tank from which it is supplied to the can filler.

The proper care of ice plants is a most important feature. There are a few general rules which apply, and are easy to remember. Over the distilled-water apparatus the greatest care should always be exercised. This is really the foundation of successful ice-making.

No more oil than is absolutely necessary should be used in the steam cylinders, and dirty water and oil should constantly be removed from the separator. In the steam condenser, as little water as possible should be used. In fact, only enough to condense the necessary amount of water to fill the ice cans.

The condensers should be kept free from scale, and the filters washed out regularly, as attention to these features will be materially improve the quality of ice.

Distilled water from the condenser should be kept as high in temperature as possible, and will then require less live steam in the reboiler. A slight amount of exhaust steam should also be allowed to escape at the relief valve in order to carry off any foul gases.

Another most important point is that the temperature of the freezing tank should be kept as high as possible, as the longer the ice takes to freeze the clearer it will be.

Many plants fall short of their full capacity by reason of the poor circulation of brine. This trouble can be avoided by watching the circulation carefully, and steps taken to correct the fault. Reference has already been made to the necessity of keeping a condenser free from scale. Ordinarily, the effect of scale depends largely upon its density. The scale formed by carbonates is usually soft and porous, and therefore easily cleaned, unless present in large quantities. In the latter case, the condenser is seriously handicapped in producing results.

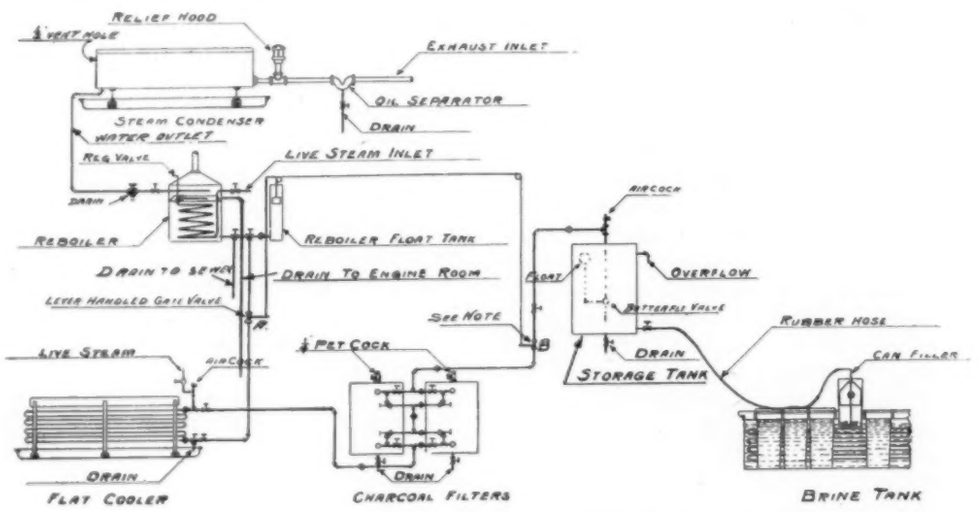


DIAGRAM OF GRAVITY SYSTEM OF DISTILLING WATER.

The carbonates of calcium and magnesium are but slightly soluble in water. Usually they combine with carbon dioxide to form bicarbonates Ca H_2 $(CO_3)_2$ and Mg $H_2(CO_3)_2$ respectively, which are quite soluble in cold water. The CO_2 is liberated by heating the water, the bicarbonates decompose, precipitating the monocarbonate (Ca CO_3) in the case of calcium, and magnesium hydrate Mg $(OH)_2$ in the case of magnesium. The temperature at which precipitation occurs varies from 180 degrees to 290 degrees.

The carbonates frequently found in cooling water are: calcium carbonate (lime), Ca CO_3; magnesium, Mg CO_3; iron, Fe_2 CO_3; also magnesium chloride, Mg Cl_2; calcium, Ca Cl_2; potassium,

KCl; sodium, NaCl. Organic or vegetable matter is at times found somewhat troublesome in the cooling of steam condensers. This is especially true when the water is supplied from nearby rivers, ponds or creeks. The exact nature of the accumulation on the cooling surface is of minor importance, the only rule leading to effective, satisfactory steam-condenser service is: Keep the condenser clean. As an illustration of this point it is only necessary to quote a well known authority on this subject who states that 1/16-inch scale reduces efficiency 13 per cent; ⅛-inch scale reduces efficiency 22 per cent; ¼-inch scale reduces efficiency 38 per cent.

In some localities it is not uncommon for one-fourth-inch scale to form in a few days. So that the importance of keeping a condenser free from scale is apparent.

Another system of making ice not previously referred to is the plate ice system. This method has been devised to make ice from raw or natural water, thus avoiding the expense of distilling the water to be frozen. With this system the water must be constantly agitated in order to carry off the air and insure clear ice.

The compressors used in a plant of this description should have a cylinder capacity of at least 18,000 cubic inches of gas per minute. A low suction pressure is necessary which reduces the weight of ammonia in circulation and necessitates the use of larger cylinders than are necessary in the can system of making ice.

In the plate ice system, filtration is the only method employed to purify the water so that it is necessary to have filters of ample capacity and of approved pattern to insure ice of salable quality.

Many central stations have found a profitable field for increasing their day-load profits by energetically canvassing for motor-driven refrigerating installations. In practically every town there are many industries such as meat markets, dairies, creameries, hotels, etc., which require refrigeration, and a profitable load has in many instances been built up by advocating the use of motor-driven refrigerating units. This side of the question is rapidly gaining ground, and there is a big opportunity here both for the central station and for the motor and refrigerating-machine manufacturers.

POWER REQUIRED FOR REFRIGERATING PLANTS.

BY SYDNEY F. WALKER.

Driving the compressors of refrigerating plants is likely to be a fairly fruitful source of income to electrical generating stations in the future. The use of refrigerating plants is steadily increasing. Like electricity itself, it is pushing its way into almost every industry. The ability to provide a current of dry air, at any temperature that may be desired, is in itself an enormous advantage, and has great industrial possibilities. The ability also to have any temperature within a very wide range at command is a great advantage. Already refrigerating plants have invaded the iron-smelting industry, and promise to invade many others.

There are three methods of producing low temperatures: by the aid of compressed air; by what is called the compression system, in which a refrigerant is used; and by what is called the absorption system, in which a particular refrigerant, ammonia, is used. The power required with the absorption system is very small and need not be considered here. The work, which is done in the compression system by a piston moving in a cylinder, is done in the absorption system by the direct action of heat, usually provided by steam.

With compressed air, a compressor of the usual form compresses the air up to a certain figure; it is then cooled and dried, and then passes into an expanding chamber, in which it is made to do work, by driving a piston whose connecting rod delivers power to the same crank shaft as that which works the compressor. So that the power delivered to the compressor piston is only the difference between that required to compress the air and that returned to the crank shaft, on the expansion of the air. In expanding, the air is reduced to a very low temperature, and in that condition is delivered to the cold chamber. After performing its work in the cold chamber, the air returns to the compressor, and goes through the cycle again.

In the compression system, one of several substances that lend themselves easily to alternate liquifaction and vaporization is employed. The substances most generally used are ammonia, carbonic acid and sulphurous acid. Ether and other substances are also occasionally used. Whatever the substance, there is a complete circuit formed, consisting of the compressor, which is really a gas pump, a condenser, in which the gas is converted to the liquid state, by the aid of cooling water, and the expansion coils. The expansion coils, which may be in the form of coils, or of a grid, do the work of cooling. In some cases, the expansion coils or pipes are placed in the chamber or in the water to be cooled. In other cases, the expansion coils are placed in a tank containing brine, which being cooled, is made to deliver the low temperature, by secondary action, to the cold chamber or the water. In what may be termed the primary circuit, the refrigerant, the ammonia, carbonic acid or sulphurous acid, is constantly passing round and round, very much as an electric current is in its circuit. There is always some gas in the compressor being compressed; there is always some gas being converted to the liquid state in the condenser, and there is always some gas expanding in the expansion pipes. There is also always some gas on its way back from the end of the expansion pipes to the suction valve of the compressor. In order that the liquid may expand to the gaseous condition, it requires to absorb a certain amount of heat, and the heat is taken from the pipes in which the gas is formed first, and secondarily from whatever the pipes may be in, the air of the cold chamber, or the brine in the tank. Every pound of the refrigerant, ammonia, carbonic acid or sulphurous acid, in expanding to the gaseous condition, absorbs a certain definite number of heat units. The number of units absorbed depends directly upon the temperature down to which the refrigerant is allowed to expand. In the case of ammonia, which is the refrigerant most generally employed, if it is allowed to expand down to zero Fahrenheit, one pound of ammonia absorbs 555.5 British thermal units; if, as is more common, it only expands down to ten degrees Fahrenheit, it only absorbs 549 units. Similarly in the case of carbonic acid, which has a much lower refrigerating effect per pound, if it is allowed to expand down to minus four degrees Fahrenheit, one pound absorbs 127 British thermal units. If it only expands down to plus five degrees

Fahrenheit, its absorbs 121.5 British thermal units. One pound of sulphurous acid similarly absorbs 173 British thermal units when expanding down to minus four degrees Fahrenheit, and 171 when expanding to plus five degrees Fahrenheit. It will easily be understood that the lower the temperature to which the refrigerant is allowed to expand, the larger is the volume of the gas, and therefore the greater is the amount of work that has to be done by the compressor. In the case of ammonia for instance, at zero Fahrenheit the vapor has a volume of nine cubic feet per pound; at minus five degrees Fahrenheit it has a volume of ten cubic feet, and at five degrees above zero, a volume of eight cubic feet; and similarly with the other refrigerants. On the other hand, the work which is required from the compressor depends directly upon the temperature of the cooling water available. In cold and temperate climates, where water of fifty, fifty-five and sixty degrees Fahrenheit is usually obtainable, the condenser pressure, the pressure to which the gas has to be compressed before it is delivered to the condenser, need only be in the neighborhood of 100 pounds per square inch.

As the temperature of the cooling water of the condenser increases so does the pressure to which the gas has to be raised before delivery to the condenser. The condenser consists of either a coil or grid of pipes, into which the hot gas from the compressor is forced, on the delivery stroke of the compressor. The gas is converted to the liquid state by the cooling action of the coldest water available, which either circulates through a tank in which the pipes lie, or is allowed to trickle over the pipes, the whole thing being exposed to the atmosphere.

The two arrangements will be recognized as modifications of the surface steam condenser, and the evaporative steam condenser. It is necessary, when converting the gas to the liquid state, that it shall be compressed before delivery to the condenser, and to a temperature that may be taken to be from five degrees Fahrenheit to ten degrees Fahrenheit above that of the cooling water. As with steam, there is a temperature corresponding to every pressure to which the different refrigerants are compressed, when in the gaseous condition, and the pressure in each case is ruled by the temperature of the cooling water. With cooling water at fifty-five degrees Fahrenheit, the temperature of the gas delivered to the condenser may be about sixty-five degrees Fahrenheit, and the corresponding pressure will be 103 pounds per square inch. In hot countries, it is sometimes necessary to use cooling water at a temperature as high as ninety degrees Fahrenheit. In those cases, the temperature of the gas entering the condenser would be 100 degrees Fahrenheit, and its pressure would be 200 pounds per square inch.

It will be seen from this how widely the demand for power may vary, under what appear to be exactly the same conditions. For instance, a refrigerating plant is turned out, presumably to do certain work. It is specified loosely to keep provisions in cold storage. Nothing is said of the temperature at which the provisions are to be held, and nothing is said about the temperature of the cooling water. The buyer knows nothing about the matter. He only knows he wants it to keep his provisions good. He may, for example, be a hotel proprietor. When the apparatus is fixed there is trouble. Perhaps it has been bought for use in Mexico, or one of the Central States of America, where it is all important during the summer to have a very low temperature in the cold chamber, and the cooling water is warm. In place of the apparatus performing its work properly, the user finds great difficulty in keeping the temperature down to anything like the figure he wants, and in addition he has endless trouble with his plant. If he had specified to the manufacturers exactly the conditions under which the plant was to be used, probably there would have been no trouble. The manufacturers would probably have advised him to purchase a larger plant than the one he has.

HOW REFRIGERATING APPARATUS IS SOLD.

Refrigerating plants are made and sold to perform one-half ton or less, one ton, two tons and upwards of refrigeration. By the ton of refrigeration is meant the equivalent cooling effect to that produced by the melting of one ton of ice in twenty-four hours. It is important to keep the time factor in mind. The latent heat of pure water, the number of heat units required to be absorbed by one pound of ice at thirty-two degrees Fahrenheit in melting to water at the same temperature is taken at 142. As the American ton is 2,000 pounds the number of heat units absorbed by a ton of ice, in melting to water is 284,000. The British ton of refrigeration is 2,240 times 142, or 318,080. These figures are equivalent to the absorption of 11,833 units per hour, or 197 units per minute, with the American ton, and 13,253 units per hour and 22 units per minute with the British ton.

A caution must be given here. The machine designed to do the work of a ton of refrigeration will not make a ton of ice. It is usual to assume that a ton-refrigeration machine will make one-half ton of ice; a two-ton machine will make one ton of ice, and so on. The reason for this is that in making ice the water has first to be cooled from its normal temperature, which in warm climates may be fairly high, down to the freezing point. It is the practice in many cases, particularly where very pure ice is required, to distill the water before delivering it to the ice-making tank. In this case, of course, the water is at a high temperature after it has been reconverted from steam. In addition, ice at thirty-two degrees Fahrenheit is very unstable. It would be very sloppy. To make stable ice, however, its temperature is lowered some fifteen degrees or so below freezing point, after actual freezing has taken place. The temperature of the blocks of ice that are sold, is at least fifteen degrees below freezing point; and solid natural ice is usually at a much lower temperature than that. The heat units required to be abstracted from the water in cooling it to freezing point, and the heat units abstracted from the ice after freezing, make up the difference between the ton of refrigeration and the ability to make ice. The specific heat of ice is only 0.5, so that the number of heat units taken out of the ice after freezing, is not very large, but it adds to the total work that has to be done. It will be noticed that in the ton of refrigeration, the heat units required to raise the temperature of the ice to melting points are disregarded. The ton of refrigeration is really a theoretical standard.

As explained above, every cubic foot of each of the substances named will absorb a certain definite number of heat units, according to the temperature to which it is allowed to expand. The capacity of the compressor, it will again be easily understood, must depend upon the quantity of gas that has

to be handled, and this again depends upon the refrigerant, and upon the temperature of the cold chamber. The compressor for carbonic acid is very much smaller than that for ammonia, and that of the compressor for sulphurous acid is larger than either. The useful volumes of the compressors for the three substances vary as 1 for carbonic acid, 7.5 for ammonia, and nineteen for sulphurous acid. The useful volume of the compressor, is that actually swept by the piston. It is the area of the compressor chamber, minus the volume of the piston, and minus the clearance. The power required to be delivered to the compressor may be found from the formula,

$$W = 0.0234 \frac{t - t_1}{460 + t} h\, Cw$$

This formula gives the theoretical horsepower required, where t is the temperature at the condenser, t_1 that in the expansion coils, h the latent heat of vaporization of the particular refrigerant, at the temperature to which it is allowed to expand, C is the net volume of the compressor in cubic feet, and w is the weight of a cubic foot of the refrigerant.

At a meeting of the Refrigeration Machine Builders in 1903, an attempt was made to standardize ice-making machines; and the rule was laid down that with ammonia, the evaporation of 27.7 pounds of anhydrous ammonia per hour at a pressure of 15.67 pounds above the atmosphere (this is about zero Fahrenheit), with a condenser pressure of 185 pounds per square inch (at which the gas would have a temperature of about ninety-two degrees Fahrenheit), should be taken as being able to produce an effect equal to the melting of one ton of ice in twenty-four hours.

A rough and ready rule has been given of a compressor capacity for ammonia, of four cubic feet per minute, as equivalent to one ton per day of refrigeration. The following figures also may be interesting. With a refrigerator temperature of minus twenty degrees Fahrenheit, and a condenser pressure of 103 pounds per square inch, one ton of refrigeration per day requires approximately one horsepower to be delivered to the compressor to produce it. This is about the lowest temperature that is usually required in a cold chamber, and the cooling water is assumed to be in the neighborhood of fifty-five to sixty degrees Fahrenheit. If the cooling water is at ninety degrees Fahrenheit, the condenser pressure being 200 pounds per square inch, and with the same refrigerator pressure, the horsepower required per ton of refrigeration is 1.6. The horsepower required decreases, as already explained, as the refrigerator temperature increases. Thus, with a refrigerator temperature of zero Fahrenheit, and cooling water at fifty-five to sixty degrees Fahrenheit, only .75 horsepower is required for the compressor. With the same refrigerator temperature, and with cooling water at ninety degrees, 1.2 horsepower is required per ton of refrigeration. These figures will represent the actual horsepower required to be delivered to the piston rod of the compressor. To it must be added the usual charge for friction, say fifteen per cent.

Another caution may, perhaps, be given. As with every other case, with small plants, the power required is larger in proportion than with large plants. Thus, a five-ton plant was found to take ten horsepower, while a fifteen-ton plant only took twenty horsepower, and a forty-ton plant fifty horsepower, and so on, the proportion of power required decreasing as the size of the plant increased.

Hydroelectric Plant in Afghanistan.

According to a recent account in *Indian Industries and Power*, the Amir of Afghanistan has sanctioned the construction of a hydroelectric power plant which will supply power to woolen mills and leather factories and will in addition light the city of Kabul. The necessity of such a plant was increased by the fact that there was but little firewood and no coal in the vicinity.

Power for this scheme will be generated at a spot forty miles distant from Kabul, a four-foot deflecting weir being constructed at a suitable gorge position. The water will be carried by one and one-fourth miles of canal over the table land bordering one side of the river, and then dropped down 130 feet by a short length of riveted-steel pipe six feet six inches in diameter, through the turbines into the tail race joining the river below.

Electric energy will be generated at 2,300 volts, transformed up through two banks of transformers, each consisting of three single-phase oil-cooled transformers. These will be wound to raise the generator potential from 2,300 volts to 44,000 volts when connected in banks of three. The main control of the plant will be effected on the 2,300-volt side from the main switchboard located in the generating station proper, and all the automatic oil switches will be in the 2,300-volt circuits. All switching on the high-tension side will be, of course, arranged in the transformer compartment of the power house. A seven and one-half-kilowatt single-phase transformer will supply the lighting circuit in the station at 120 volts.

Owing to the lack of wood previously referred to, the forty miles of transmission line will be supported on a forty-foot steel tower at fifteen to the mile, thus eliminating what is usually the weak spot in most hydroelectric installations in new countries. A soft-steel ground wire will be carreid above the transmission line for the whole length. A telephone line will also be fixed connecting the main and substation with various patrol houses en route. At the substation in Kabul the transformers for stepping down the voltage to 2,300 volts for delivery to the shops will again consist of two banks, each consisting of three single-phase oil-cooled transformers. The Kabul local transmission lines will be carried on tubular poles connecting with the three shops above referred to.

A number of 2,300-volt induction motors will replace the existing steam sets driving the various shafting, etc., while the steam hammers will be operated by compressed air from suitable receivers, the air compressors being driven also by electric motors.

Japanese Hydroelectric Project.

A Japanese water-power company, to be known as the Yokohama Suiryoku Denki Kaisha, is being organized with a capital of $2,500,000. It intends to utilize the power obtainable from the rapids of Sakawa River in the Kanagawa prefecture.

Steel for Magnets.

An alloy containing 8 per cent of molybdenum, 0.3 per cent of vanadium and 0.6 per cent of carbon is said to make good permanent magnets, which retain their magnetism up to a temperature above 1,000 degrees centigrade. Four per cent of tungsten with 0.4 per cent of vanadium has also been found to be a good combination.

ELEMENTS OF POWER-STATION DESIGN.—XXXII.

TYPICAL HYDROELECTRIC PLANTS.—III.

BY W. B. GUMP.

SIOUX FALLS PLANT.

A development of the short-diversion type is exemplified in the plant of the Sioux Falls Light & Power Company at Sioux Falls, S. D. There are a number of unusual features in connection with this development, which will appear in the course of the following description.

The general character of the development program is shown in the map, Fig. 14. Here it will be seen that the Big Sioux River widens toward the north, thus offering a large reservoir from which a pipe line leads to the power station about 600 feet distant.

The decision was made in favor of a vertical installation, one of the reasons being that the high foundations required would insure a permanently dry station, since the floor could be brought to a point above flood level.

An unusual feature of the plant is the adoption of spiral-case turbines, instead of the cylindrical type more often employed in plants of this nature. The normal operating head is seventy feet, but this varies to a considerable extent due to floods.

On account of the fact that there is a difference of thirty-three feet between the lowest tail water and flood level, the practical draft-tube head is exceeded during the flood season, which was the most important factor favoring vertical turbines.

The station is located within a mile of the city of Sioux Falls, this fact adding greatly to the economy, both in first cost and maintenance, since high-tension transmission, involving both step-up and step-down transformers, was entirely avoided.

The service is made up of lighting and railway power, which demands close regulation and a means of properly accommodating heavy peaks. As there are but few cars in operation, the fluctuations are more severe than those in a larger system, hence the electrical side of the plant involved some difficult problems. It may be said, however, that these have been met quite successfully.

The drainage area from the source of the Sioux River to the dam at Sioux Falls covers an area of approximately 1,100 square miles and has an average flow of 1,000 cubic feet per second. The minimum flow in freezing weather is 120 cubic feet per second.

Fig. 15 shows a sectional elevation of the plant, and Figs. 16 and 17 show floor plans of the generator and turbine rooms, respectively. The general design of the station is self explanatory.

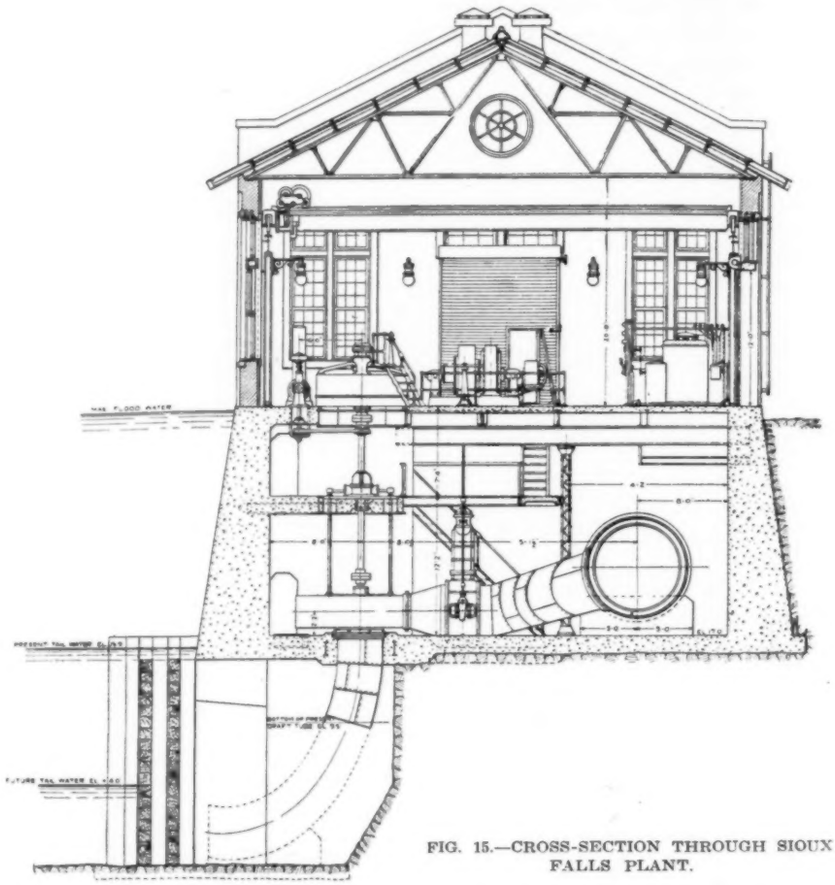


FIG. 15.—CROSS-SECTION THROUGH SIOUX FALLS PLANT.

The three main turbines are rated at 850 brake horsepower when running at 300 revolutions per minute and are of the single-runner, vertical type. The casing is constructed of plate steel. The Allis-Chalmers Company supplied the turbines and generators. The latter are 500-kilowatt, three-phase, sixty-cycle, 2,300-volt machines, of the same general construction as the standard water-wheel type alternators made by the same manufacturers.

FIG. 14.—MAP OF HYDRAULIC DEVELOPMENT AT SIOUX FALLS, S. D.

The turbine governors are of the oil-pressure type. The turbine gates are of the swivel type, actuated by shafts and connecting links. A distinct advantage in swivel gates over the cylindrical type is found in the fact that the latter form of gate hinders the flow of water, especially on light loads, thus causing more or less loss of hydraulic efficiency. With the swivel gate such loss is reduced to a minimum. In addition to this, the power expended in operating the swivel gate is uniform, while this is not true with the other type.

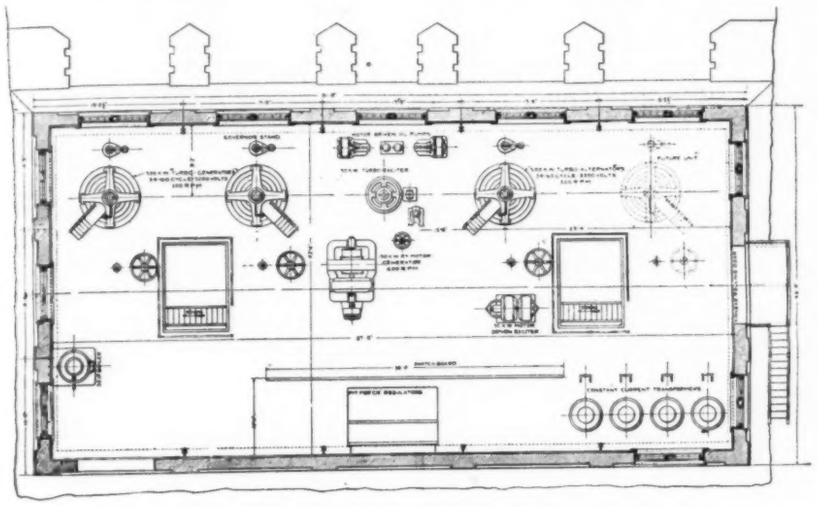


FIG. 16.—PLAN OF GENERATOR FLOOR, SIOUX FALLS PLANT.

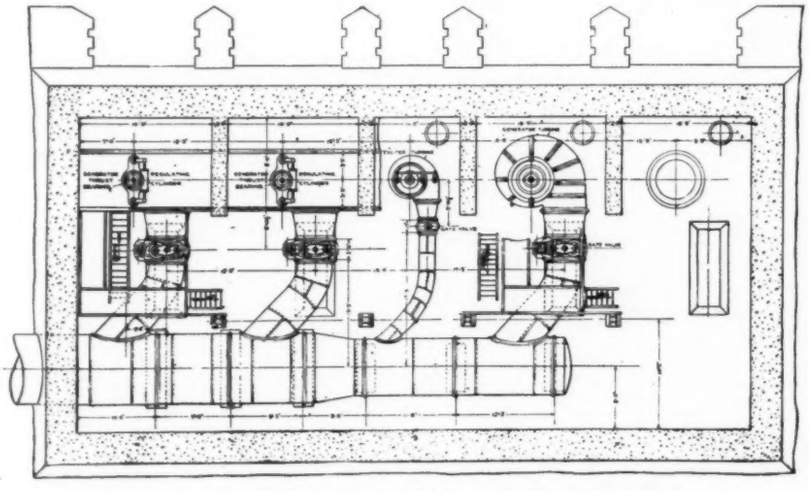


FIG. 17.—PLAN OF TURBINE FLOOR, SIOUX FALLS PLANT.

Field excitation is derived from either one or two sources, a turbine-driven exciter, or an induction motor-generator. These are each rated at fifty kilowatts output. The potential of each is 125 volts.

In addition to the motor-generator just noted, there is a second motor-generator for railway service. Its driving power is a three-phase synchronous motor, operating at 2,080 volts and sixty cycles.

The switchboard is of the vertical type, constructed of natural slate panels mounted on pipe supports seven feet from the wall. It is equipped with a sychronism indicator located on a swinging bracket, one double exciter panel, one induction motor and regulator panel, three alternating-current generator panels, one blank generator panel, two three-phase feeder panels, one blank feeder panel, three single-phase two-circuit panels, one three-phase synchronous-motor panel, one blank motor panel, one railway generator panel, one 600-volt railway feeder panel, one blank feeder panel and one panel for power feeders.

At the rear end of the switchboard is a pit for regulators. The lightning arresters are located on the walls. Four series arc-light transformers are installed at one end of the station.

The power station substructure is of reinforced concrete throughout. The superstructure is of red jasper stone, obtained from the immediate locality. With this form of construction the building presents an unusually pleasing appearance.

A few additional remarks with respect to the hydraulic features are worthy of some space. The main dam is 589 feet long, and has a maximum width at the base of eighteen feet. The depth varies from four to eight feet. The spillway extends over the entire length. The dam contains five sluice gates, each measuring four by five feet, located at the entrance to the intake.

The main pipe line or penstock is 680 feet long and seven feet in diameter; it is constructed of plate steel. A standpipe or surge tank is connected to the pipe line at a point just outside the station. This tank is sixteen feet in diameter and sixty-two feet high, affording sufficient capacity for sudden fluctuations, and relieving the main line from undue pressure. Expansion and contraction of the pipe line is taken care of by three expansion joints.

The velocity of water entering the intake is slow, in order to lessen ice trouble. An arch or curtain wall is used under which the water is made to flow without carrying ice. Headgates are located at the entrance to the forebay, so that ice accumulating at this point may be intercepted and directed over the spillway.

(To be continued.)

[EDITOR'S NOTE.—This important series of articles was started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and before its conclusion will cover every phase of central-station design.]

Overcoming Boiler Corrosion.

The Canadian Pacific Railway Company is planning to protect the boilers of its locomotives from corrosion by utilizing electric currents. These are conducted into the boiler in such a direction that the electrochemical action producing corrosion is overcome. This method is cheap and tests conducted in Australia were successful. It has been advocated by a number of scientists, but this is the first known application of it in America.

POWER-PLANT BETTERMENT.

BY H. H. HUNT.

In this article is undertaken a brief discussion of some of the problems which arise in the work of power-plant betterment, by which term is meant improvement in economy of operation and maintenance. While the discussion will, in the main, be of a general nature, and therefore applicable to power plants in general, it is particularly applicable to the steam-driven electric power plant of the public service company of moderate size.

The general tendency toward consolidation has extended to power plants, and many of the smaller ones have been replaced by large central stations of modern design, operated by high-priced men and with great refinement. There are, however, many of the smaller plants which for good and sufficient reasons are still in operation and which must be operated in the future. In the face of the upward tendency of wages, cost of apparatus and materials and the downward tendency of rates and increasing demands for improved service, the public service company of today is in a position where the question of economy all along the line, and particularly in that most important part of the property—the power plant—is one of vital importance.

A casual inspection of one of these small power plants will usually reveal a more or less heterogeneous collection of apparatus and machinery, some of which dates back to the early days of the business. In other words, the plant is by no means modern and up-to-date. This, together with the fact that such a plant is usually operated by a force of engineers and firemen of only ordinary intelligence and ability, might naturally lead to the conclusion that, even under most favorable conditions, high power costs are to be expected.

On the other hand, a careful and detailed examination by an expert in power-station operation will almost invariably reveal many features which are capable of marked improvement, enabling the expert to report recommendations which, if properly carried into effect, will result in material reductions in costs of manufacture and maintenance, and all this to be accomplished without the expenditure of a large amount of money.

In undertaking the betterment of operating conditions in a power plant, attention should first be given to the personnel of the operating force. Desired results can not be obtained by incompetent men. It goes without saying that the chief engineer, who must be primarily responsible for what takes place in the plant, should be a man of both operating and executive ability, capable of enforcing strict discipline. He must be capable of receiving instruction, as must also the other members of the force. Each man who does not possess the possibility of becoming a throughly efficient and alert member of the force should be replaced as soon as possible. Most careful study will be required in arriving at correct conclusions in reference to each individual of the operating force in order that justice may be done. It not infrequently happens that certain men develop unexpected ability as they gradually become familiar with the methods by which actual improvements are brought about. Furthermore, every reasonable opportunity should be given the existing employees to measure up to the new requirements in order to avoid the demoralization to the organization which would be caused by the needless discharge of men. Under the improved conditions the general tone of the power-station force should improve in a marked degree, and in place of indifference and lack of ambition should be found alertness, efficiency and a greatly increased interest in the work, all of which are necessary to success.

A thorough physical examination of the plant should be made and immediate steps taken to correct such defects as can be remedied without excessive cost. Starting in the fire room, for instance, boilers will be thoroughly overhauled and cleaned, leaky tubes replaced, blow-off cocks and valves made tight, gauge glasses and dampers put in order, air leaks in boiler settings removed, furnace linings, bridge walls and grate bars put in order, safety valves adjusted and steam gauges calibrated, etc.

The work will continue in like manner to the engines, paying particular attention to valve setting; steam piping; pumps; condensers; heaters; oiling system and electrical machinery, apparatus and wiring and all other parts of the plant.

In connection with this general overhaul of the machinery, all gauges, meters and measuring instruments should be calibrated and tested, so as to give accurate information regarding the operation of the plant.

Attention should also be given to the matter of tools, and it should be seen that a suitable assortment is provided, both for the engine room and the fire room.

Finally, the station should be thoroughly cleaned and all housekeeping matters given proper attention, for while, theoretically, there may be no connection between cleanliness and economy, a dirty, ill-kept plant indicates inefficiency.

With the physical plant in good working condition and the power plant crew in an alert and receptive mood, the details of operation may now be taken up.

All firemen should be individually instructed in the handling of the particular coal in use; the use of properly designed fire tools, the proper operation of the dampers and proper control of the draft. A thorough course of training along these lines will usually be found necessary, and it will be further necessary to instruct the chief and watch engineers in every detail of the proper handling of the fires in order that they may be able to maintain intelligent oversight of the fire room.

Special attention should be given to the maintenance of boiler pressure and temperature of feed water, in order to avoid the usual fluctuations which so largely affect station economy. Recording-pressure gauges and feed-water thermometers and a bulletin board in the fire room, on which are posted the coal consumption and pressure records of each watch, will serve a useful purpose in exciting rivalry among the men. It is in the fire room that money, in the shape of fuel, is actually burned. At this point the fuel, which is the source of power, is consumed. It is essential that no detail which will affect fire-room economy should be overlooked. An operating engineer can profitably spend a good portion of his time in intelligent personal supervision of the fire-room operations.

1 Abstract of paper presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

Presumably the engineers will understand such matters as the starting and stopping of their engines and generators; neverthless, the attention of the expert should be carefully directed to the engine room.

It is of importance to provide operating schedules so that the varying conditions of load may be met by the economical use of apparatus; in other words, so as to avoid the use of three boilers when two are sufficient, and so on. A most careful study of the load conditions should be made and charts prepared which will show clearly just what combinations of apparatus and machinery should be used to meet the various conditions of load, the idea being to so arrange the schedules that each piece of apparatus, when in use, will be operated as nearly as possible at its point of maximum efficiency.

A carefuly designed station log should also be provided which will contain the daily operating data of the plant recorded in a systematic manner. In such a station log it is very desirable that the main facts, such as coal consumed per kilowatt-hour, water evaporated per pound of coal, etc., be shown so clearly that the manager of the company, by spending a few minutes daily in the study of the station log, may fully acquaint himself with the daily operations of his plant and be in position to intelligently discuss matters with his chief engineer.

The coal question is one of the most important, and one of the most troublesome, which is encountered in power-plant operation. The quality of coal must necessarily depend, to a certain extent, upon the location of the power plant as related to the sources of coal supply. It will be found profitable to have a careful investigation made of the possible sources from which coal may be secured at reasonable prices. Full data should be gathered regarding the analysis of the various coals available and that coal selected which will meet local conditions with best results. While not always practicable, it is none the less desirable to purchase coal on the analysis basis under carefully drawn specifications which provide for forfeiture and bonus according to whether the coal falls short of or exceeds the requirements of the contract. Under such a contract an analysis of each shipment of coal is necessary. Where the annual consumption is comparatively small, it is not practicable to purchase coal on the analysis basis, in that event the best that can be done is to buy it of responsible dealers who handle the best coal to be had under the circumstances.

The accounting for coal purchased, while seemingly simple, proves in practice more or less troublesome. Coal is frequently purchased and paid for according to bill of lading weights. The consumer is liable to suffer shortage under this method of purchase and to start out with substantially less coal in his coal pile than is called for by his books. It is obvious that ultimately the cost of the coal consumed must check with the cost of coal purchased, and in order to bring about this agreement, frequent checks between station records, coal on hand and fuel accounts are necessary. It will be found desirable to arrange proper scales for weighing in bulk the coal which comes into the yard, and if a contract for purchase can be so arranged as to make payments on basis of company's weights, one question of coal shortage will be removed. Bins should be provided which will enable the coal supply to be accurately measured at any time. Then the coal passing into the fire room must be carefully weighed and weights recorded. With these data at hand and this system carefully followed, there is no excuse for coal shortage.

Proper and systematic maintenance is an important part of power-plant-betterment work. It is not infrequently the case that the maintenance of a plant is handled in a haphazard fashion and that full value is not received for the money expended. It is not sufficient to wait until something breaks before giving it attention, for the breakdown may occur at a time when the machine is needed to maintain countinuous service, to say nothing of the excess cost of repairs over what would probably have been the case had the condition been anticipated and the break avoided. Low cost of maintenance does not always indicate thorough or economical maintenance, for while it may be possible to run for months on abnormally low maintenance costs, the time will come when the accumulation of deferred maintenance will produce a condition of affairs which will require excessive expenditures, if not for new apparatus, certainly for the overhaul and repair of the old. A log book should be used in connection with the maintenance schedules, and in this log book should be carefully recorded, in detail, the results of all inspections, repairs, adjustments, etc. By the aid of this maintenance log and a careful adherence to the maintenace schedule, proper maintenance of every part of the plant will be assured and unexpected breakdowns practically avoided.

Line Trouble Caused by Birds.

Trouble caused on South African high-tension transmission lines by birds is even more common than flash-overs brought about by lightning, according to a paper which was read before the South African Institute of Electrical Engineers by C. W. R. Campbell.

The part of Mr. Campbell's paper relating to this phase of trouble on South African lines states that: "With insulators the chief troubles experienced have been through flashing over caused by lightning, or by birds, and I fancy the bird trouble is the greater. I say this because of the numerous instances in which birds are found at the foot of the pole in question, with signs of burns. One of the most curious instances of this occurred a short while ago, a tremendous amount of pitting on 40,000 and 10,000-volt lines taking place at one spot, and a small bird of the 'fink' breed being found badly burnt underneath. As the stretch of the bird's wings did not appear to be enough to cause any ground or short, I have been unable to make up my mind whether the bird caused the trouble or happened to be there when the flashing started. The number of birds, chiefly hawks, found beneath the lines is really astonishing. The curious part of this is that the bird is not always killed or even seriously injured, so that many trips on a line, or broken insulators, may be caused by birds, and yet no birds be found. This would be difficult to believe, but I personally have seen three cases, and have heard of others. The cases I have actually seen were of two pigeons and one hawk; in the case of the hawk the flash was seen and the bird dropped, but on picking him up he came very much to life. The pigeons I mention, after dropping down, immediately recovered and flew away without apparent injury. It is very necessary when designing a line in this country to bear in mind the large hawks and owls. Kaffir cranes and wild ducks are also troublesome."

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

Discoloration of Metal Lamps.

Every dealer in electrical goods is familiar with the claim made by the manufacturers of metal-filament lamps that the bulbs do not blacken during use. Before these lamps were employed to anything like the extent they are at present a few isolated cases of blackening were met with, the discoloration taking place within a comparatively short time of the lamp being placed in service. Such blackening, however, was the exception rather than the rule. The faulty lamps were returned to the makers, who examined them to ascertain the cause of the trouble; methods of manufacture were improved, and the claim made was fully substantiated.

This state of affairs has lately changed somewhat, and a number of users complain of ring-marking and general discoloration occurring in their lamps. It is unfortunate that grounds for such complaints exist, as it is not to the interests of any section of the industry (despite the views that may at one time have been held and expressed by many station engineers) that any dissatisfaction should be felt with regard to the new high-efficiency lamps by any users of electrical energy.

Complaints are also heard that the filaments are more fragile than was formerly the case, but this is certainly incorrect. It is possible that owing to the number of lamps which are turned out every day from the factories an almost infinitesimal proportion of lamps that should be rejected, escape notice and pass into use, but the cause underlying the complaint is the increasing carelessness of users. When the public was warned by everyone concerned that the lamps were fragile and could only be used vertically downwards, they were treated with care. Now they are not only handled carelessly, but many are fixed in positions where they are exposed to a good deal of vibration, and it is only natural that the percentage of breakages should be on the increase. It may be asserted without fear of contradiction that the metal lamp of today is not only better made, but possesses a filament considerably stronger than did the lamp of two years ago.

But no amount of careless handling, of vibration, or of rough usage can cause a lamp bulb to blacken. Such discoloration can only be due to defective manufacture, broadly speaking; and it is only by exercising greater care in eliminating all traces of carbon from the filament, or by improving the methods by which the filaments, joints, leading-in wires, or supports are made that blackening can be prevented.

Many electrical engineers and contractors hold the opinion that the blackening is largely due to over-running. Every supply voltage varies during the day, but it is the usual custom to install lamps suitable for a higher voltage than the circuit on which they are fixed, in order that such fluctuations of pressure shall not adversely affect the filament. Moderate over-running does not in itself cause blackening. In support of this contention it may be mentioned that the writer has had two tungsten lamps in service since the beginning of 1907. They are rated at 100 and 105 volts, respectively. They were first wired in parallel on a 100-volt alternating-current circuit and were in ordinary domestic use for eighteen months. They were then removed and placed in series on a 220-volt direct-current service and are still in constant use. One certainly burns a little more brightly than the other, although it would require a good eye to detect this; the candlepower has not fallen off appreciably and the bulbs are free from discoloration of any kind, and are, in fact, as clear as on the day when the lamps came from the factory. It may be mentioned that the initial consumption of the lamps was approximately 1.3 watts per candlepower. These lamps show, therefore, that neither lengthy burning nor over-running cause blackening and there is no doubt that the idea is merely a notion born of long experience with carbon-filament lamps.

The discoloration found in the bulbs is frequently of a reddish-brown color. True blackening is of course met with occasionally and when it occurs it is almost always evenly distributed on the glass. The brown stains are streaky, running parallel with the filaments; the positions of the leading-in wires and supports are also generally shown by the stains on the glass.

Evidently, therefore, there is more than one cause for the discoloration, and whilst blackening may occur in rare instances from some as yet unknown cause, it may be stated at once that it is usually due either to carbon remaining in the filament in the shape of a carbide of tungsten; or to the presence of some slightly volatile tungsten compound which has not been wholly eliminated during manufacture. It is also due occasionally to the presence of carbon in the leading-in wires or supports, or to some volatile constituent of these parts being driven out by the heat of the filament.

It is common knowledge that in the majority of cases tungsten filaments are not wire in the true sense of the word, but are built-up, so to speak, from particles of the metal joined together in a more or less homogeneous mass by the influence of heat. To cause the particles to cohere in the first place they are combined with an agglutinant which generally contains carbon, although many makers have been conducting experiments with binders which are free from that element. The heating to which the filaments are subjected after they are squirted not only sinters the particles of metal together, but also drives off to some extent the carbon, which is afterwards, or during the preliminary heating, as the case may be, subjected to an attack from some gas, which at the same time reduces the tungsten powder, which is usually a compound of the metal, to the true metallic form.

The earliest method of carrying out

this removal of carbon was by raising the squirted filament to a white heat in an atmosphere of hydrogen containing steam. The carbon was thus changed to carbonic oxide or carbon dioxide while the metal was prevented from oxidizing by the hydrogen. It was found, however, to be most difficult to prevent the filament oxidizing to some extent and it was almost impossible to eliminate the whole of the carbon. The employment of a comparatively high temperature, together with an excess of hydrogen, did not prevent the trouble occurring. The moment the whole of the carbon contained in the outer skin of the filament had combined with the oxygen in the steam, the gas began to attack the metal itself. Many experiments were then tried with nitrous oxide, dry air, or some other volatile oxygen compound in place of the steam, every trace of moisture being removed from the vessel in which the filament was being treated. In order to insure that no water vapor passed in, the reducing and decarbonizing gases were first driven through some substance such as phosphorus pentoxide, concentrated sulphuric acid, or chloride of lime.

Another method which was tried with some measure of success was to replace the oxidizing gases by others which would not act by oxidizing the carbon, but in another manner altogether. The gases used contained nitrogen, either in the form of a mixture with a large proportion of hydrogen, or as gaseous ammonia. The effect was that the carbon was removed in the form of cyanogen, or hydrocyanic acid. There was no danger of oxidizing the filament, and the process allowed a greater freedom in working.

The employment of binding materials into which carbon does not enter in any way has already been mentioned. A substance of this nature which may be specifically mentioned as having been the subject of exhaustive experiment and from which some most satisfactory results have been obtained is zirconium oxalate. This is prepared by precipitation from a solution of zirconium nitrate heated to a certain temperature with ammonium oxalate. The effect of this is to throw down a gelatinous precipitate resembling starch paste with a smooth and even consistency. It may be mentioned that there is little or no difficulty in obtaining perfectly pure zirconium oxalate by this process.

The method adopted by Dr. Hollefreund for decarbonizing filaments is one of the most successful in commercial use that have been introduced. In this the removal of the carbon is effected by means of gases containing nitrogen, which are produced by heating, in a vacuum, hydrogen and nitrogen containing phosphorus compounds, or their oxygen and sulphuric compounds. Amongst these compounds may be mentioned specifically phosphoric amidoamide and phosphine. In describing the process Dr. Hollefreund has stated that in the manufacture of incandescent lamps it is essential that the finished filament should be entirely free from carbon for the reason that "if even a small amount of carbon be contained in filaments it interferes very prejudicially with the strength and serviceableness thereof. It is difficult to work on a commercial scale most of the processes hitherto proposed for the purpose of obtaining filaments free from carbon and they rarely allow of the carbon being entirely removed without the means for the purpose attacking the metal from which the filament is formed."

The date of this quotation is 1906, and it would appear evident that every lamp in which the filament contains any traces of carbon is certain to blacken eventually, and that unless the removal is carried out under test-room rather than factory conditions, the filament will be injured. The failure, commercially, to remove the whole of the carbon is probably the cause of a fairly large percentage of the cases of blackening with which one meets.

One of the most fertile sources of discoloration is the metal, other than tungsten or tantalum, as the case may be, that is contained in the bulb in the shape of filament supports or leading-in wires. This metal or metal compound frequently contains gases or volatile compounds which are driven out by the temperature to which the filament is raised. In cases where the markings on the glass show the outlines of either the supports or the connections they are most probably due to the above cause.

The third principal cause of blackening that need be mentioned is the accidental presence of some volatile tungsten compound remaining in a free state in the filament after it has been heated finally with a view to sintering the particles together. Special pains are taken by lamp makers, all of whom recognize the importance of the point, to insure that no such compound remains in the filament after it is ready for sealing into the bulb. At one time it was doubted by many that such volatile compounds could exist after the filament had been subjected to high temperature, but there is no doubt on the point.

The subject of the discoloration during the life of metal lamps is interesting and wide, and should at any time the history of the early attempts to make a commercially successful metal lamp be written, the chapter dealing with the methods tried for the purpose of preventing blackening will be one of the longest and most fascinating.

Chicago Section, Illuminating Engineering Society.

The Chicago Section of the Illuminating Engineering Society met on the evening of May 18 in the new Peoples Gas Building, Michigan Boulevard and Adams Street, Chicago. The members first availed themselves of the opportunity to inspect the building and its gas lighting equipment. At 8:30 p. m. the meeting was opened in the magnificent office on the main floor, the attendance being nearly 100.

Charles A. Luther, illuminating engineer of the Peoples Gas Light & Coke Company, read a paper entitled "The Illumination of the Peoples Gas Building," in which he described the many distinctive features of the gas lighting equipment.

The Peoples Gas Building is a handsome office building, twenty-one stories high and 171 by 196 feet in ground area, with a central court 60 by 70 feet. It was constructed for the local gas company, which occupies four entire floors and parts of four others, as well as the two basements for its various offices. The rest of the office space is leased to tenants. These have the option of having their rooms lighted either by gas, electric or combination fixtures. All of the gas company's offices and all the corridors, stairways, etc., as well as the outside of the building, are illuminated by gas. All of the gas fixtures are of original design. Those on the first two floors and in some of the company's executive offices are of solid bronze, weighing as high as 500 pounds apiece in some types; in keeping with the lavish architectural design, in which rich marbles are profusely employed, the prominent fixtures are of highly ornate design and are chiefly hand-finished.

For lighting the exterior twenty high-pressure gas units are mounted between the columns at the second floor line. The spaces around the skylight in the main office are lighted by twenty-four pendent high-pressure units, each suspended by four hangers and provided with a single-inverted mantle. Two motor-driven booster sets raise the gas pressure from that of the city mains, three and one-half ounces to two pounds per square inch for the forty-four lamps on the

high-pressure system. In the center of the main office are ten upright bronze standards, each equipped with three upright mantles. There are also a large number of bronze three-light brackets with inverted mantles, and inverted-mantle bronze pendent lamps on the first and second floors. The upper corridors are lighted by enameled fixtures with inverted mantles.

The offices are generally lighted by semi-indirect units with three upright-mantle burners partly concealed by a hemispherical art-glass dome. Throughout the rooms and corridors of the building the lighting is quite uniform and abundant. The illumination of the main floor is very attractive. For operating all the ceiling fixtures or those more or less inaccessible, a double-tube pneumatic system is employed which opens or closes the gas cocks, a small pilot light being left burning all the time.

In reply to various questions, Mr. Luther said that it requires about one and one-half minues for the thermostat and heater of the high-pressure lamps to bring them up to full incandescence after they are turned on. The booster blowers for the high-pressure are kept continually in operation. The pilot lights consume but little gas and are very seldom blown out.

Those taking part in the discussion were Albert Scheible, G. C. Keech and W. E. Barrows. The general feeling among those in attendance was that the gas-lighting installation was unique not only for its size, artistic appearance and good illumination, but as showing what may be achieved by the gas-lighting fraternity.

A nominating committee, consisting of G. C. Keech, J. R. Cravath, O. R. Hogue, F. A. Vaughn and C. A. Luther, was appointed to present a list of nominees for officers of the Section to be elected at the next meeting, which will be held June 15. W. D. Bradley, of the American Luxfer Prism Company, will present a paper on "Natural Daylight Illumination" at this concluding meeting of the season.

Use of a Line Choke Coil to Raise the Candlepower of Flaming Arcs.

An English company manufacturing flaming arc lamps has pointed out that the use of a choke coil instead of a non-inductive resistance with alternating-current flaming arc lamps increases the light given out by the lamp at the same time it reduces the power consumption of the unit. Oscillograms show that the current curve at the beginning of each cycle of an alternating-current arc lamp with series resistance is flattened and distorted. When a choke coil is used instead of the resistance, the current lags behind the pressure so that the latter has risen to a considerable value before the current wave sets in; consequently the current rises to full value much more rapidly than it does when it is more nearly in phase with the pressure. The bright period in each cycle is, therefore, lengthened compared to the dark period, and this produces a higher net candlepower. When tested on a circuit having a sine electromotive-force wave, the combined increase in candlepower and decrease in power consumption amounted to thirty-six per cent.

Statistics of Street Lighting.

Conditions affecting the cost of both electric power and gas vary greatly from plant to plant and from city to city. Unit costs which are found in one installation are sometimes utterly inapplicable to another, even though the conditions appear to be somewhat similar. Such differences apply to neighboring towns almost as forcibly as to different countries, and the statistics of cost for street lighting by gas and electricity given in the accompanying table will prove almost as valuable as though obtained in towns in this country.

The figures given in the table have been gathered from thirty-one English towns and boroughs, and apply to the year 1910. They were compiled by H. Tomlinson-Lee, chief electrical engineer of the Borough of Wimbledon, and published in *The Electrical Engineer*.

This comparison of cost between gas and electric lighting is on the basis of candlepower per annum, so that the relative cost is shown for equal illumination. Figures are lacking for certain of the towns considered, but the average of the figures available show that lighting by gas causes more than double the expense of lighting by electric current; in fact, the cost is nearly 2.5 times as great. The advantage on the side of electric lighting applies almost equally to the use of arc or incandescent lamps.

ANALYSIS OF CANDLEPOWER AND COST IN THIRTY-ONE TOWNS AND BOROUGHS.

Town	Population	Miles of streets lighted	Number of Lamp-posts				Candlepower			Cost of Electricity per Annum, including Renewals, Repairs and Attendance	Cost of Gas per Annum, including Renewals, Repairs and Attendance	Total Cost per Mile per aunnm	Cost per Candlepower per annum (Electricity)	Cost per Candlepower per annum (Gas)	Total Cost per Candlepower per annum
			Arcs	Incandescent Electric	Gas	Total	Electric	Gas	Total per mile						
													Cents	Cents	Cents
Bournemouth	75000	104	157	—	2350	2507	160000	188000	3338	$12,400	$28,600	$393	7.7	15.2	11.8
Blackpool	65000	70	272	775	2270	3317	190000	60000	3571	28,000	26,200	775	14.7	43.7	21.7
Chelsea	73842	—	—	—	1646	1646	—	255000	—	—	28,500	—	—	11.2	—
Camberwell	279566	132	—	—	4555	4555	—	273180	2066	—	58,500	443	—	21.4	21.4
Deptford	112000	50	—	—	1899	1899	—	120810	2416	—	23,200	463	—	19.1	19.1
Ealing	52000	53	72	817	870	1759	256850	52790	5815	21,800	9,950	596	8.5	19.0	10.3
Eastbourne	51000	48	97	16	1400	1513	146300	70000	4506	9,800	22,600	675	6.7	32.3	15.0
Finsbury	95289	37	—	—	1861	1861	—	240000	6486	—	33,800	912	—	14.1	14.1
Fulham	165000	62	226	914	1025	2165	407550	41000	7235	38,400	18,000	972	9.4	43.7	13.4
Gloucester	55000	45	175	10	1200	1385	100000	80000	4060	10,900	15,900	595	10.9	19.8	14.9
Hammersmith	127413	57	254	521	902	1677	145300	44022	3321	27,400	14,800	736	18.8	33.5	22.3
Hampstead	81942	62	136	1021	1501	2658	324480	—	5212b	26,700	24,600	825	8.3	—	—
Holborn	53937	26	—	—	1924	1924	—	185000	7184	—	34,500	1340	—	18.6	18.6
Harrogate	33000	60	1	700	1520	2221	38400	—	—	3,650	6,300	—	9.5	—	—
Islington	334991	124	615	32	4125	4772	1167936	190044	10951	74,000	63,750	1110	6.3	33.5	10.1
Kingston	40000	29	81	291	481	853	56900	29505	2929	9,450	11,500	710	16.6	39.0	24.2
Lambeth	301895	153	25	—	5155	5180	12500	298000	2029	—	63,100	413	—	21.2	20.4
Lewisham	164899	132	—	—	3305	3305	—	127835	968	—	38,400	292	—	30.1	30.1
Leyton	122000	66	98	1558	—	1656	273900	—	4119	42,000	—	631	15.4	—	15.4
Paddington	152000	60	—	—	4011	4011	—	245000	4083	—	56,500	943	—	23.1	23.1
Poplar	168822	62	342	571	895	1808	208892	35625	3912	44,000	12,800	910	21.0	36.0	23.2
Portsmouth	217986	137	420	486	1924	2830	728600	—	5318b	34,600	29,600	468	4.7	—	—
St. Marylebone	134000	62	87	3500	—	3587	405000	—	6532	—	—	—	—	—	—
St. Pancras.	235317	90	947	70	1623	2640	997500c	97380c	12165c	77,500	25,800	1148	7.8	26.6	9.4
Southwark	206180	65	108	158	2368	2634	339800	333240	10354	17,550	38,800	940	5.2	11.6	9.1
Surbiton	19000	26	—	2	681	683	—	—	—	32	11,200	423	—	—	—
Wandsworth	344900	208	5	—	6147	6152	5000c	553230c	2677c	124	88,300	424	2.5	16.0	15.8
Westminster	183011	99	1080	183	2903	4166	—	—	—	118,000	63,500	1833	—	—	—
Woolwich	129000	78	153	263	1714	2130	285000	78000	4654	18,200	19,400	481	6.4	24.8	10.3
Wood Green	51000	30	—	—	1090	1090	—	86000	2838	—	14,800	487	—	17.2	17.2
Wimbledon	58222	46	91	1136	—	1227	313500	—	6839	32,300	—	705	10.3	—	10.3
Average									4892a			738	10.05	24.8	16.72

NOTES—(a) Exclusive of Hampstead and Portsmouth. (b)—Electric only; gas not given. (c)—Candlepower estimated.

Cheap Lighting in Stockholm, Sweden.

As another step towards the popularization of electricity the city of Stockholm, Sweden, is taking steps toward doing away with meters for customers with a maximum of three simultaneously-lighted metal-wire lamps of twenty-five candlepower each, and substituting a current-regulator or flickerer.

The charge, independent of the time the lamps are lighted, will be fixed at $8.85 per annum per 100 watts (which corresponds with the above-mentioned three lamps), and $0.54 per year for the regulator or limitator. It will, however, also be possible to have only one lamp, which will cost $2.95 per year and the $0.54 for the regulator. The plan also admits of more than three lamps being installed, but only three can be lighted simultaneously, for if a greater number of lamps is turned on, the limitator comes into action and interrupts their use. This scheme gives very cheap lighting for small customers.

FIG. 1.—ILLUMINATION OF FIFTH AVENUE, NEW YORK, LOOKING NORTH FROM FORTY-THIRD STREET.

FIG. 2.—BOULEVARD LIGHTING IN SEVENTH AVENUE, HARLEM, NEW YORK CITY.

STREET-LIGHTING EQUIPMENT IN NEW YORK CITY.

BY H. THURSTON OWENS.

The large and growing interest in the subject of street lighting has received its due share of attention in the metropolis, although the methods have been along the lines of a general improvement rather than any radical departures. The fixtures generally used have for many years held a place quite distinctive owing both to their appearance and to the care taken of them.

NUMBER, TYPE AND COST OF PUBLIC LAMPS.

The greater city has a population of nearly five millions, an area of 207 square miles and some 3,000 miles of highways. The number of public lamps has been continually increased, totaling 75,800 at the present time.

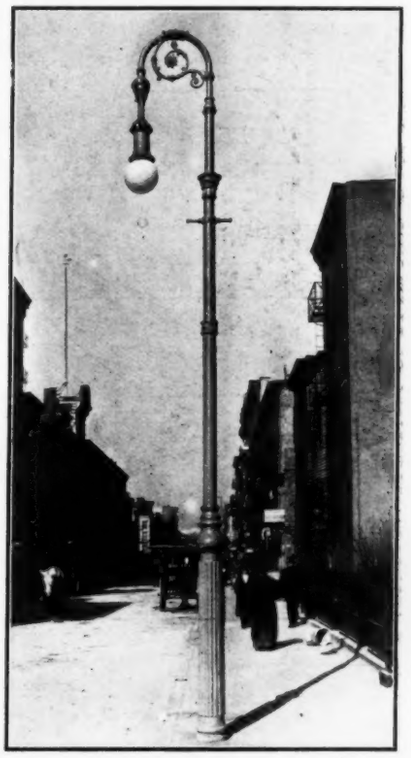


FIG. 3.—BISHOP'S-CROOK TYPE OF LAMP-POST.

These lamps are divided into the following types: gas, about 44,500; naphtha, 1,800; arc, 17,000; incandescent, 12,500. In addition to the above there are approximately 500 arc and 600 incandescent lamps on the bridges which are supplied at flat rates.

The gas and naphtha lamps are all of the upright-mantle type, giving a nominal sixty candlepower, the cost, in-

cluding all repairs and painting, ranging from $23 to $28 per annum. The city owns and supplies the posts for gas and some of the electric incandescents, the cost of the latter ranging from $26.50 to $29, including repairs and painting. The majority of the incandescent lamps are either sixty-nine to eighty-one-watt series or seventy-eight to ninety-two-watt multiple lamps.

The arc lamps are all of the inclosed type with the exception of twenty flame lamps. The inclosed-arc lamps use 450 watts each and cost from $95 to $100 each per annum. The flame lamps are used in pairs, costing $320 annually per pair.

FIG. 4.—TYPICAL LONG-ARM ARC POST IN BROOKLYN.

FIG. 5.—SHORT-ARM POST NEAR SLOCUM MONUMENT, BROOKLYN.

FIG. 6.—ORNAMENTAL LAMP-POSTS NEAR SLOCUM MONUMENT.

TYPES OF ELECTRIC FIXTURES IN MANHATTAN.

Probably the most noteworthy features of the public lighting installation is the handsome and permanent type of fixtures which are used, there being over 10,000 all-iron electric posts. This feature is, of course, more important by day than at night. A lighting feature of note is the large number of streets where diffusing globes are used.

One of the latter streets is shown in Fig. 1, which is a view in Fifth Avenue, where twin arcs are placed three to the block, about ninety feet apart, for a distance of two and one-half miles. Fig. 2 shows a night view in Seventh Avenue, Harlem, where single lamps, also equipped with diffusing globes, are placed three to the block. These lamps are disposed as follows: two at the curb on diagonally opposite corners and one in the center of the grass plot dividing the two roadways of the boulevard. The former lamp-posts have long bracket arms similar to those of Figs. 4 and 5, placing the lamps well beyond the trees; the center posts are of what is known as the "lyre" type. The posts used in these installations have been illustrated in previous issues of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, particularly the issue of January 1, 1910.

The same equipment shown on Seventh Avenue is used on Broadway and these two thoroughfares aggregate over seven miles of brilliantly lighted highway. The three installations referred to have been placed in service in less than three years.

The type of arc post adopted by the New York Edison Company for general lighting, particularly where traffic is heavy, is known as the "bishop's crook," the crook being shown on the post in Fig. 3. This has a cast-iron base and a wrought-iron tubular shaft. The center posts in Fig. 2 are similar except that they have a lyre top.

During the past year both the New York and the Brooklyn Edison companies offered the city a considerable reduction if the number of arc lamps were increased, and this was accepted with the result that the lighting on a number of prominent thoroughfares was greatly improved.

Two night views of Broadway and its surroundings, Figs. 7 and 8, taken from the Times Building, Forty-second Street and Broadway, show in a striking way the effect of the regular night lighting upon the appearance of the heart of the city.

BROOKLYN FIXTURES.

Two types of arc fixtures are used by the Edison Electric Illuminating Company of Brooklyn. These are shown in Figs. 4 and 5, as provided with a long and short arm. As in the case of those in Manhattan, the lamps are direct-current multiple, 450-watt arcs. The switch is placed inside a door in the base. There are also a large number of special fixtures of handsome design in use throughout Brooklyn at monuments, squares, bridges, etc. One design is shown in Fig. 6, which shows in more detail the ornamental post seen near the Slocum monument in Fig. 5. Another type of special lighting equipment is employed on each side of the steps leading to the residence of Mayor Gaynor. The custom of placing lamps before the home of the chief magistrate has been one of long standing in New

FIG. 7.—NIGHT VIEW OF BROADWAY, LOOKING SOUTH FROM THE TIMES BUILDING.

FIG. 8.—VIEW OF BROADWAY, LOOKING NORTH FROM THE TIMES BUILDING.

York City, probably the oldest of these lamps having been erected in 1846.

MERCHANTS' LIGHTING.

The system of merchants' lighting has received but scant attention in New York, although a few installations are now in operation in Brooklyn, one being shown in Fig. 9. Plans are now under way to extend this system rapidly in this borough during the coming year. The city requires that these lamps shall be at least ten and one-half feet above the pavement and that one lamp in each cluster shall burn for the full city schedule of 3,950 hours.

EQUIPMENT.

The details covering the various equipments used in New York public outdoor lighting are given in the accompanying table, which gives the number of lamps and posts of different classes. The practice of using series lamps for street lighting, which is quite general throughout the country, is used only in the outlying portions of the city. Practically all of the lamps supported on iron posts are supplied from underground circuits with low-tension current, about half of the arc lamps being so connected. Two important exceptions are the installations made during the past year upon the Grand Boulevard and Concourse in the Borough of The Bronx, and that made a number of years ago upon the Ocean Parkway leading to Coney Island in Brooklyn, where series underground service is used. In a few cases the city has supplied the fixtures and here a reduction of $5.00 per annum is made by the lighting company. Where the city supplies posts, lamps, wiring, and conduits the reduction amounts to $10 per annum.

The tungsten lamps used for highway lighting are of the series type equipped with reflectors and attached by means of brackets to the wooden poles carrying the transmission lines, the standard height being fifteen feet above the roadway. These lamps with iron posts are used for park and boulevard lighting and have displaced naphtha mantle lamps in most of the larger parks.

The major portion of the underground all-iron equipment is to be found in the old city of New York, the Borough of Manhattan, where more brains and money have been used in planning and perfecting the public lighting than in any similar area in this country and perhaps in any other.

Electric Lighting in the Society Islands

An American consul has reported the following interesting note regarding the installation of electric lights at Papeete in the Society Islands:

C. A. F. Ducerron, an American, has just installed an electric light plant in Papeete with a capacity of 3,000 twenty-candlepower lamps. He also has in operation seventy-four telephones on the island of Tahiti, and a wireless-telegraph station by which news may be received from or conveyed to vessels 180 miles from port.

Mr. Ducerron's first lighting contract was to wire the permanent residence of the governor general, which proved so satisfactory that he was employed to illuminate Papeete. The streets had always been poorly lighted with dim lamps at great intervals, and as the new contract provided for sufficient lights to enable one to see the time, by a watch, at any point on the street, the realization of this plan was indeed an innovation. The natives stand and gaze at these wonderful new lights by the hour, and many long voyages are made by the curious inhabitants of neighboring islands just to have a look at the brilliant city. At every street crossing there is one 100-candlepower light, and at all other necessary places forty-candlepower lights have been used. The current is turned on thirty minutes after sunset, as there is no twilight there. At 11 o'clock the 100-candlepower lamps are replaced by those of forty-candlepower, and these burn all night.

The power station consists of four dynamos—two of thirty kilowatts, one

FIG. 9.—TUNGSTEN CLUSTERS IN FLATBUSH AVENUE, BROOKLYN.

TYPE AND EQUIPMENT OF ELECTRIC LAMPS IN NEW YORK CITY.
December 31, 1910.

Boroughs	ARC LAMPS												INCANDESCENT LAMPS											
	Low Tension		High Tension		Circuit		Company Fixtures			City Fixtures			Low Tension		High Tension		Circuit		Company Fixtures			City Fixtures			
	A.C.	D.C.	A.C.	D.C.	Underground	Overhead	Iron Posts	Wood Posts	Brackets	Iron Posts	Spec'l Posts	Brackets	A.C.	D.C.	A.C.	D.C.	Underground	Overhead	Wood Posts	Iron Posts	Brackets	Wood Posts	Iron Posts	Spec'l Posts	Brackets
Manhattan	509	4055	45		5464	45	5354		48	81	8	12	248	2022	59		2270	59		3	93	59	2070	98	6
The Bronx	29		2694		230	2493	183	2477	8	55			12		1783		14	1781	1777		6	1	4		7
Brooklyn	70	2659	880	2322	2577	3354	2326	3568	2	20		13	60	553	5	36	585	59	69				583	2	
Queens	31		2158		31	2158		2156	2	31			24		3768		24	3768	3768				24		
Richmond			762			762		762							3881			3881	3881						
Total	639	7014	6539	2322	8302	8812	7863	8963	60	187	8	27	344	2575	9496	36	2893	9558	9495	3	99	60	2681	100	13

of ten kilowatts, and one of five kilowatts. The entire plant, steel poles, and all the fixtures employed were supplied by American firms.

Annual Meeting of the Philadelphia Electric Company Section.

The annual meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held on May 15. The entire time of the meeting was taken up in the election of officers for the coming season and the chairman's annual report.

This report consisted of a review of the work of the past season and a summary of the reports of the various committees.

The secretary's report mentioned that the Section meetings are strictly business meetings, the social feature being avoided, and recommended that greater benefit could be obtained by the individual members and more credit by the Section if such practice were continued.

The membership of the section has increased in the past season 87 per cent, which is a most excellent showing when it is considered that no inducements outside of the educational features are offered to members. This increase is due to the energetic work of the Sub-Committee on Membership.

The Committee on Departmental Branches reported that three branches had been formed during the past season, namely, Meter, Accounting, and Commercial Branches, all of which are in a flourishing condition, and holding regular monthly meetings. The papers presented at the meetings of the branches are devoted to their particular lines of work, which naturally makes the papers of vital interest to all in attendance. This permits the meetings of the local section to be devoted to general topics, which are selected so as to be of interest to the company at large.

The following officers were elected to serve for the ensuing year: chairman, Thomas Sproule; vice-chairman, R. B. MacCreery; secretary, B. Frank Day; executive committee (two-year term), J. T. Maxwell, J. D. Israel, C. J. Russell, Jos. B. Seaman; (one-year term), George Ross Green, P. H. Bartlett, A. H. Manwaring, A. R. Granger. The treasurer and three members of the executive committee are to be appointed by the president of the Philadelphia Electric Company.

LETTERS TO THE EDITOR.

Selective Radiation from Tantalum.

To the Editor:

In the abstract of the paper for the Physical Society on "A New Determination of the Selective Radiation from Tantalum," as printed in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for April 29, a slight error has been called to my attention. In the sixth column on page 843 the results on the ratio of luminous efficiency of tantalum to carbon are given to within one decimal place, whereas in the original table the figure in the second decimal place was given as a subscript. It modifies the conclusion somewhat to have this second figure omitted. For example, at approximate black-body temperature of 1,780 degrees, by omitting the second decimal figure, which was a 7, the luminous efficiency of tantalum appears to be the same as that of carbon, whereas according to our original measurements we found it to be different by ten per cent. Similarly, by omitting the second decimal figure at the other two temperatures the present results are apparently different from the older results, whereas to within the accuracy of the measurement they agree quite well. The second place was placed as a subscript because we could not be sure that it was correct to within +1.

May I ask that you publish the table again corrected, since the corrections are necessary in justification of the conclusions which I stated in the paper? EDW. P. HYDE.

Cleveland, O., May 17, 1911.

[The table referred to is reproduced herewith.—ED.]

SELECTIVE RADIATION FROM TANTALUM.

Approximate Black-body Temperature Centigrade.	Measured Luminous Efficiences in Lumens per Watt.		Corrected Luminous Efficiencies in Lumens per Watt.		Ratio of the Luminous Efficiency of Tantalum to that of Carbon.	
	Carbon.	Tantalum.	Carbon.	Tantalum.	Present. Results.	Previous. Results.
1420	0.373	0.481	0.419	0.519	1.24	1.3
1610	1.41	1.70	1.59	1.82	1.14	1.15
1780	3.15	3.56	3.52	3.76	1.07	1.1

Gas and Electric Street Lighting.

To the Editor:

The valuable historical articles on street lighting have a flavor of antiquity which is interesting and amusing, but why should some of the anecdotes be quoted as having a place in the history of today? In your issue dated May 13 your contributor states that "when four or more mantles, each of 200 or 300 nominal candlepower, are grouped together * * * the advocates of gas will tell you that there is practically no limit to the size of the lighting unit obtainable with gas."

Under ordinary pressure (three inches of water) using five mantles over 600 actual mean lower-hemispherical candlepower can be obtained with fifteen cubic feet of gas. Under high pressure (5.6 inches of water) using three mantles, over 4,500 mean lower-hemispherical candlepower can be obtained with eighty-five feet of gas. The grouping of mantles shows a gain instead of a loss as the larger quantity of gas consumed keeps the lamps hotter and therefore the regenerative effect is greater, thus increasing the efficiency to a greater extent than the loss occasioned by the interference of the mantles.

The mud-slinging contention as to depreciation can easily be overcome if contracts were let for so much actual measured candlepower instead of so much nominal candlepower or so many kilowatts of current. The recent contract for lighting Westminster, London, where gas displaces electricity, was let on this basis.

The advantage of electricity in that it can be controlled from the central station and the lamps lighted and extinguished on time is another back number.

In a large number of progressive American cities it has been found good practice to use the multiple system in all congested districts, and the number of lamp-lighters (switch-throwers) is increasing rather than diminishing.

The statement that "even in England, the gas lamps are being steadily crowded out," is one which would carry more weight were the statistics given to show that this were the case. The facts might be stated in a truer light had he said that the time of the technical societies in England was being taken up by cohorts of vociferous votaries of a certain "system of illumination" who crowded out the gas speakers, just as we have witnessed in this country in the past few years. Notwithstanding these facts the gas business in both countries is flourishing as never before. ENGINEER.

New York, N. Y., May 16, 1911.

TELEPHONY—TELEGRAPHY, and WIRELESS.

HARD-DRAWN COPPER WIRE.[1]

BY THOMAS B. DOOLITTLE.

In the fall of 1877, while acting as an agent for the Bell Telephone Company, I received an order from the Ansonia Brass & Copper Company to connect its office and mills by telephone. Samuel Cotter was the general superintendent of the mills. To him I addressed myself, stating that I wished to build those lines of copper wire and to have the wire drawn under my own direction. I well remember his reply: "You can build them of gold if you want to." Thereupon he accompanied me to the wire mill, where he instructed the superintendent to detail a man to do whatever I required.

The problem (if it could be solved at all was to draw a rod of a given size (or number) down to a wire of given size (or number) without annealing, and in this way to produce a wire with the proper tensile strength and ductility. A rod of Lake Superior copper was procured and the experiment began. After repeated trials with rods of different sizes and by the use of many "holes" or dies, in order not to crystallize or granulate the metal by too much strain, the desired result was accomplished, but not until after many trials in which we found the finished product either too brittle or too soft.

It is an interesting fact that drawing the wire eleven numbers produced the result then, and today the hard-drawn copper for line purposes is referred to by the manufacturer as "eleven numbers hard." Although the product is known to the trade as hard-drawn copper wire, and properly so known, as the name indicates its property of hardness and the method of manufacture, the name has no contra term, because soft-drawn copper would be a misnomer. The very process of drawing eliminates the quality of softness and makes it hard.

Previous to the introduction of hard-drawn copper wire much thought and large sums of money had been expended to get the benefit of the superior conductivity of copper for electric line conductors. The first recorded employment of copper wire as a line conductor was its use by Professor Morse in his experimental line between Baltimore and Washington. The ordinary market wire was used, but for the reason that it would not sustain its own weight it was abandoned and iron wire was substituted.

The next on record was strung by the Western Union Telegraph Company in New Jersey. In this case also the ordinary copper wire was used. This proved unsatisfactory and was taken down. An attempt was made to increase the tensile strength by doubling and twisting it. This was done and the wire was put up again. It was still unsatisfactory and was again taken down. This information I had from one who was employed upon the work.

In another experiment steel wire was used with a copper ribbon wound spirally about it. In another case the copper ribbon was folded longitudinally about the steel wire. In another the copper was electroplated on the steel wire. This latter was adopted by the American Rapid Telegraph Company on all of its lines and was manufactured by Wallace & Sons in Ansonia, Conn.

This went the way of all the others for the reason that a chemical action was set up between the steel and copper which destroyed the steel. There were many other and equally futile attempts along the same line. It is to be admitted that the advent of the telephone created a great demand for electric conductors of high conductivity, but it is unaccountable, when we consider the amount of money that had previously been expended and the amount of work that engineers and inventors had given to the subject, that it had occurred to no one to avail themselves of the simplest possible thing—hard-drawn copper wire, unless, metaphorically speaking, there was no sailor present to suggest "wetting the rope."

The work of connecting the several mills, offices, and residences of the officials of the brass company was carried on to completion, all lines being of hard-drawn copper. A switchboard was placed in the office of the brass mill and placed in charge of Charles A. Cotter, son of the general superintendent. This was, undoubtedly, the first private-branch exchange in the world.

One circuit was connected to the freight house of the Derby & New Haven Railroad, which could be and was, occasionally connected through to New Haven. This exchange was discontinued on the complaint of the Connecticut Telephone Company on the ground that it was a telephone exchange and that it, the Connecticut company, held exclusive rights for exchange purposes in the territory. A portion of the wires in the Bridgeport exchange were of hard-drawn copper and these continued in service for seventeen years, or until they were displaced by underground cable.

The wire showed no deterioration. I had the greatest difficulty in trying to introduce this wire. I urged it upon several companies, including the Western Union Telegraph Company. At last I secured the promise of a company to make tests of it, provided the wire could be furnished at the cost of iron. I made the proposition to the Antosia Company without success. One day I met Col. Fred Mason, president of the Bridgeport Brass Company, who said to me:

"Doolittle, there should be something in the telephone field that would interest us."

"There is," I replied, "but you wire people have no sand."

[1]Abstract from *New England Telephone Topics.*

"What do you mean?" said he.

"You will not do what I ask," I replied.

"Now wait; I will do anything you ask," he said. "Now, go ahead."

I explained that I wished him to furnish a given amount of hard-drawn copper wire at the price of iron, pound for pound.

"I will do it," he said. "Send in your order."

I immediately went to the manager of the telephone company and made arrangements for him to send in his order. I went on a long business trip and when I returned was informed that the wire had been strung. I went to the place to see it and make a test and found, much to my surprise and disgust, that they had strung common market wire, cotton covered. They said in explanation that, it being an experiment, they had ordered cotton covered wire so that, if it proved a failure, it could be taken down and used for inside wiring. Of course it proved a failure. The first rain soaked the cotton and the whole line sagged.

In another case I had almost persuaded the management of a company to string a metallic circuit of copper wire between two important cities, but at last they weakened and, instead of that, they strung a number four iron with a ground circuit. The unusual size and conductivity of this wire only served to increase the induction to a point where it was almost impossible to talk over it. The fact that the hard-drawn copper wire had been in successful use for about five years appeared to have no weight.

The objections to hard-drawn copper, without any investigation whatsoever, were of many kinds. That it was too costly; that it would stretch and sag; that it would not stand exposure to the elements; that the structure of the metal was impaired by the process of drawing; that the conductivity was reduced to a point where it would be little, if any, better than iron; that it would be stolen, etc. The most amusing objection was that it would expand from heat of the sun, and not contract to normal when cool. Some one said that if this was the case, it was foolish to draw the wire, for it would only be necessary to lay a rod of copper wire out into the sun. Then with a few hot days and cool nights it would draw itself.

William Wallace went to the trouble to refute the latter objection by suspending 200 feet. He then placed a graduated scale midway between the two supports and turned on an electric current. This heated the wire and the expansion caused it to drop down the scale. The wire was then allowed to cool, when it gradually returned exactly to its original position on the scale.

Finally, the subject was brought to the attention of Theodore N. Vail, then general manager of the American Bell Telephone Company. He, with his usual comprehensive grasp of things, authorized me to build a metallic circuit of hard-drawn copper wire between New York and Boston. When Mr. Vail inquired of me regarding the manufacture of the wire, I related to him the experience of Colonel Fred Mason of the Bridgeport Brass Company, and explained to him that his company was loser some hundreds of dollars, and that it would be only fair to give them the contract.

Mr. Vail asked me to send for Colonel Mason, which I did, and a contract was made with him, specifying that the wire should be drawn under my personal supervision. The wires were strung on the poles of intervening companies between New York and Boston as far as their lines extended, the gaps being filled with new lines. A contract was made with the S. N. E. T. Company to string the wires and build the necessary lines. The work was placed in the direct charge of J. K. Butler.

In December, 1877, I sent samples of the first hard-drawn copper that was made to Boston for tests. After a year of exposure I sent another sample. In February, 1881, at the request of Thomas A. Watson, engineer of the Bell Telephone Company, I made a report on the condition of the wire and forwarded samples of both the old and new wire. My report was referred to Mr. Vail, who instructed Dr. W. W. Jaques, electrician, to make a test of the wire for conductivity, as compared with soft-copper wire, and also as compared with iron wire, and as well with the new hard-drawn copper wire that had not been in service. There was shown to be no perceptible deterioration in any way.

On this last test and report I built great expectations, and rightly, for the product had proved in beyond any reasonable doubt. These expectations were for the general interest of the telephone business, and the public, and not on account of any monetary reward by reason of a proprietary claim, as will be seen.

Soon after the wire had been in public use, I consulted my attorney, William Cranch McIntire, of Washington, D. C., regarding the possibility of covering the product with a patent. After hearing my story, he advised me that a patent could be secured as a "new article of manufacture." He then drew the specifications and waited for my order to apply for patent.

At the expiration of two years, after the wire had been in public use, the time had expired within which, under the law, a patent could be issued. I had made no progress in extending the use of hard-drawn copper wire beyond the system of the Ansonia Brass & Copper Company and my own telephone exchange in Bridgeport, Conn. I was not in a financial position to take any financial chances whatsoever, and so the subject of a patent was dropped. The production of the wire having waited for the man with knowledge of the subject and its application, so its development awaited a man with financial backing, ability and broad comprehension of its possibilities.

Accordingly, in 1883, six years after hard-drawn copper wire had been in constant and absolutely successful service, General Manager Theodore N. Vail commissioned me to build a metallic circuit of number twelve Birmingham gauged hard-drawn copper wire between Boston and New York. The cost of this experiment was estimated at about $70,000. It must be remembered that in those days and within the telephone interests, $70,000 was a very large sum of money, and in my opinion no man in or outside of the telephone business other than Mr. Vail would have had the courage to undertake the enterprise. I heard it referred to derisively as "Vail's baby."

On account of the indifferent success with iron grounded circuits there was a general apathy throughout the country regarding toll lines. Many difficulties were encountered in building the lines and stringing the wires. Not the least of these was the inclement season. Mr. Butler stated to me that his men had not a dry thread upon their backs for two months. Notwith-

standing this, the work was pushed vigorously in rain or sunshine.

At this time all the wires were overhead, consequently our copper circuit had to be strung through the network of every intervening city on poles and over housetops. When at last the lines were completed and ready for test, the industrious stringing of exchange wires in the intervening cities kept us in trouble almost constantly. Five minutes with an absolutely clear line was a rarity during the day. Most of the testing and calculations were made at night. The blasting of rock in Westchester county frequently tore down our lines.

I shall not forget one scene when all of the directors of the Bell Telephone Company filed into my little room at the corner of Greenwich and Liberty Streets, with solemn tread, for the purpose of testing the new copper circuit. I had arranged for men to patrol the whole distance between New York and Boston for this occasion. Everything had been working perfectly; conversation was carried on between the two cities as though it were only a block distant.

I was in a state of nervous tension, as I understood this to be the deciding hour. I called for the laboratory in Boston and got no response; we waited —called again and again. My assistant, E. H. Lyon, made a galvanometer test of the circuit which indicated a clear line. There was no induction. After a half hour the directors filed out.

I called the test station on the north side of the Harlem river and received no response. I then sent a man to Harlem who, in the course of two hours, reported to me that a tugboat, towing a lumber barge, had caught our cable and taken out about 250 feet, and that both of our wires were grounded in the bottom of the river.

A few days served to repair the damage, a test was made by the directors from the Boston end of the line, and the result was then approved. During the time that the test and experiments were being conducted, I was visited by Messrs. Preece, of England; Wabner, of Germany, and Berton, of France, each at the head of the telegraph and telephone department of their respective countries. Each climbed the three long flights of stairs leading to my little den, after which each returned home and immediately instituted the manufacture and use of hard-drawn copper wire. The Postal Telegraph Company was the first of the telegraph companies to adopt it in this country, its whole system being built of it.

On August 15, 1885, the American Telephone & Telegraph Company was organized with Theodore N. Vail as president, myself as vice-president, and Edward J. Hall as secretary and general manager. Mr. Hall, who had an extraordinary fitness for the position, was made the executive head. My position was tentative, and I soon resigned and resumed my work on the broad lines of development throughout the country.

The development of the American Telephone & Telegraph system was rapid, hard-drawn copper wire was generally adopted for toll lines and very largely for exchange lines throughout the world, and its use is constantly increasing. As far back as 1896 the output for the year in this country alone was upwards of eighty million pounds.

With regard to the manufacture of hard-drawn copper wire in recent years, great improvements have been made in the process of manufacture, which cover all operations from the ingot to the finished product. When my experiments were made, it was the practice to roll a billet of copper, say of six or eight inches in width, into a long sheet and then, after being annealed, it was taken to a slitting machine and slit into square rods.

These rods were tapered by means of a hammer, in order that they might be inserted far enough through the drawing die to be grappled on the opposite side, after which they were ready to be drawn into wire. This method of starting with a square rod had disadvantages for the reason that the corners were likely to lap and fold over in the process of drawing, thereby producing flaws or bad places in the wire, these flaws becoming more and more troublesome in the smaller sizes of wire. After having been drawn through a certain number of "holes," the surface requires that it should be annealed before any further reduction in size is practicable. The new process is substantially as follows:

DESCRIPTION OF NEW PROCESS.

The copper is received from the smelting works in the form of wire bars, which are approximately fifty-four inches long, with an average diameter of about three and three-fourths inches, and weigh about 200 pounds each. These are delivered as commercial copper wire bars.

The first operation is to put the bars into what is termed a "continuous furnace," bars going in at one end of the furnace and taken out at the other. In their passage through they are heated to about 950 degrees centigrade at the rate of about two bars per minute.

The heated bars are then put through a series of grooved rolls. Each succeeding groove being smaller, the result is a reduction of the three and three-fourths-inch bar to a diameter of five-sixteenths inch. These are now called rods, and are taken up on a reel in the form of a coil about thirty inches in diameter. These coils are then taken from the hot-rolling department and are cold at that time. They are then plunged into a bath of sulphuric acid and water for the purpose of removing whatever oxide has been formed in the hot-rolling operation. After about twenty minutes in this solution, the oxide is removed and the rods are then taken and thoroughly washed with clean water under a high pressure from a hose; after which they are immersed in a vat containing a lubricant of tallow and soap. The rods are now ready for the drawing process.

The rods are substantially drawn on what is termed by wire manufacturers a "continuous wire drawing machine." That is to say, the five-sixteenths-inch rod goes in at one end of the machine, and, after passing through several dies, each one reducing the diameter and hardening the wire, it finally is drawn around a block to the finished size, say 0.104 inch.

In making this reduction, the copper is reduced in diameter from number one wire gauge to number twelve wire gauge or, in technical terms, the wire is "eleven numbers hard." This process gives the wire the greatest amount of tensile strength possible from commercial copper and yet preserves its elasticity. The cost of production is enormously reduced by the new process. Whereas, under the old process, a very skilled workman was required for each single drawing, an

attendant is now able to care for several continuous drawing machines that are run at a speed unapproachable by the old method. In the smaller sizes of wire, diamond dies are employed which, in themselves, represent a very considerable investment.

Commercial copper in its soft state has a tensile strength of about 28,000 pounds per square inch, with an elongation of about thirty-six per cent, and by the cold-drawing process above described the tensile strength is increased by each number drawn, and the elongation is reduced; therefore when the copper wire is drawn eleven numbers hard it has a tensile strength of about 64,600 pounds per square inch, with an elongation of about one per cent. The wire is then taken from the wire-drawing blocks, so called, and is carefully inspected for tensile strength, elongation, torsion and conductivity. The inspected wire is then carefully packed by wrapping each coil with burlaps, so that it does not become bruised or damaged in any way by transportation.

The cost of hard-drawn copper wire fluctuates with the price of ingot copper and at present writing is quoted as sixteen cents per pound. The relative cost of copper and iron wire, say of number twelve, is three and three-fourths cents for iron and sixteen cents for copper.

The advantage of copper over iron, besides what is shown in the table herewith, is that it is practically indestructible, except from mechanical injury, and if it receives mechanical injury it can be made over into new wire at a cost of about two cents per pound, while iron, which is subject to rapid deterioration from rust, is worthless when taken down.

The output of hard-drawn copper wire has steadily increased from year to year.

The comparative properties of number 12 N. B. S. gauge copper and iron wire are given in the following tables, this being the size in the largest general use as telephone toll-line conductors.

The wires of a pair are supposed to have a separation of twelve inches on centers. In calculating the inductance and effective resistances, a frequency speed ($2\pi N$) of 5,000 has been taken, while assuming a permeability of 100 for the iron wire.

The following tables have been revised by Dr. Jewett through the courtesy of J. J. Carty, chief engineer:

	Electrostatic Capacity No. 12 N. B. S.	Diameter in Mils.	Resistance per Wire-Mile 68 degrees Fahrenheit in Ohms.	Inductance per Pair Mile in Millihenries.	Effective Resistance per Wire-Mile in Ohms.	Electrostatic Capacity per Pair Mile Micro-microfarads.	Miles equal to one Mile Hard-drawn Copper for Telephone Transmission
Soft copper....	104	5.1	3.66	5.1	8350	1.02
Hard drawn copper.....	104	5.2	3.66	5.2	8350	1.00
Iron B. B.....	104	36.0	17.2	47.0	8350	0.26

	No. 12 N. B. S.	Diameter in Mils.	Weight per Wire-Mile in pounds.	Tensile Strength in pounds.	Torsion in Six Inches.	Elongation in per cent.
Soft Copper	104	173	290	50-75	40
Hard drawn copper	104	173	550	25-45	1
Iron B. B.	104	153	450	45	18

The above figures represent average commercial conditions. The ordinary commercial copper wire is assumed to have a conductivity of ninety-nine per cent of that of pure soft copper, while that of the hard drawn is ninety-seven per cent.

Much of added interest could be written were the writer to disregard trade secrets.

Meeting of the Southwestern Telephone and Telegraph Company.

The district and commercial managers of the Southwestern Telephone & Telegraph Company met at Fort Worth, Texas, on May 12 and 13, the business of the meeting consisting of the reading of papers on various telephone and telegraph subjects. Papers read were as follows: "Interdepartment Relations," by H. D. McBride; "Duties and Responsibility of a Commercial Manager," H. M. Cox; "Relation Between Manufacturers and Telephone Companies," Paul Joslin; "Personality as a Commercial Asset," R. D. Laney; "The Relation of the Manager to the Telephone Industry from the Plant Standpoint," Louis Rosenberg; "Proper Methods of Developing Rural Business," R. W. Williams; "Telephone Accounting," F. E. Bedlow; "Sale of Service, and How to Develop Business," J. M. Corrol; "Collection Methods," H. G. Brickhouse; "Preparing Directory Copy," G. H. Yetman; "How to Develop Small Exchanges," H. D. Philipps.

A Strange Prophecy and Its Fulfillment.

In 1865, Wendell Phillips, the mellifluous Boston orator, made an address on a public occasion connected with the schools of that city, when, after expatiating on the wonders of the telegraph and the Atlantic cable, which were then of recent date, further stated that he confidently expected that in forty years messages would be sent without the use of wires or submarine cables.

Strange to remark, it was forty years later, or in 1905, that the achievements of Marconi fully established the truth of the prophecy.

Although his experience and surroundings were academical in their trend, Phillips was a close student of science and inventions, and his lecture on the lost arts represented years of investigation.

Telephone Cable Installation.

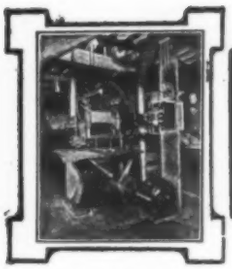
At a recent meeting of the Philadelphia Telephone Society, James Cunningham, supervisor of construction of the Bell Telephone Company of Pennsylvania, read an interesting paper on "Construction," which was reprinted in the May 15 issue of *The Telephone News*. In this paper is given the results of experience with both underground and aerial cable installation. Various economical methods of rodding and pulling cable into conduits and drawing it out are described, also quick methods of setting poles and stringing overhead cable on them.

Hudson & Manhattan Traffic.

The recent report of the Hudson & Manhattan Company shows an increase of forty-seven per cent in the number of passengers carried this year over that carried last year. During the month of April the total number of passengers carried was 4,842,248, compared with 4,164,024 for April, 1910. This is an increase of sixteen per cent over the previous year. This gives a daily average of 161,408 for April, this year, as against a daily average of 138,801 in 1910.

A Large Swedish Power Plant.

A Swedish water-power plant which was recently put in operation at Vemark in the province of Telemarkon, is said to be capable of developing 145,000 horsepower. There is in the river a fall of about 1,400 feet.



Industrial Power

The Driving of Hoisting Engines by Induction Motors.

In a paper dealing with this subject which was recently presented before the (British) Institution of Electrical Engineers, H. J. S. Heather brings out a number of significant features in favor of the induction motor for this class of service.

For hosting and winding work on a polyphase system of electric supply the direct application of the driving power of the induction motor has not hitherto been so general as its indirect application through the medium of continuous-current plant operated on the Ward-Leonard control system, with or without the Ilgner flywheel. The principal causes which have prevented the adoption of the less costly direct induction-motor drive have been, first, the losses arising from the waste of energy in the rheostatic control; and, secondly, the difficulties arising from the nature of the relations between torque, speed, and resistance in the secondary circuit of the induction motor.

Some tests carried out by the author on a three-phase hoisting unit for the Village Main Reef Gold Mining Company in 1906 convinced him that the first of these two objections was more or less groundless. The author then obtained figures for the over-all efficiency—that is, for the relation between the foot-pounds of useful work done in lifting rock in the shaft, and the input into the system (measured, of course, in kilowatt-hours), which compare on practically equal terms with the most satisfactory results that he has seen given for a converter system. It should be mentioned that in these tests the circumstances were unfavorable to the three-phase motor, as the distance hauled through was short and the drive was through a reduction gear.

It is therefore with the second objection only that the author deals. It is obvious that if the control of the direct-coupled three-phase motor can be made as safe and simple as that of the continuous-current motor of the Ward-Leonard set, the extra risk involved by the use of the continuous-current generator and the three-phase motor driving it, as links in the chain of power supply, will be prevented, and the balance of security will be in favor of the direct three-phase drive. In hoisting operations where men are raised and lowered security is the consideration of paramount importance.

It will accordingly be necessary in the first place to investigate wherein lies the acknowledged simplicity of the Ward-Leonard control. In this system there is a continuous-current winding motor in which the field strength is of constant value, being derived from a separate source of supply and of fixed direction. The current passing through the armature of the motor is adjustable both in value and direction. This result is secured by regulation and reversal of the field of the continuous-current generator, the armature of which is connected to that of the hoisting motor. This continuous-current generator is driven at practically constant speed by a motor connected to the main power-supply system. The result of these arrangements is that the torque exerted by the hoisting motor is proportional to the current passing through its armature, and a reversal of this current causes a reversal of the direction of the motor torque. When the torque is in the direction of the hoisting motor's motion the motor is putting out mechanical work, but when the torque is opposing the motion, as in braking or in lowering a load more slowly than it would fall under the action of gravity, the hoisting motor changes its function and becomes a generator, driving as a motor the machine which under the former circumstances had been acting as a generator. The motor connected to the supply mains now, also, reverses its function and becomes a generator, forcing into the supply mains electric power derived from the descending load in the operation of braking. The control is therefore regenerative, and it becomes possible to utilize a large proportion of the power which would otherwise be wasted.

The method of control above described is usually effected by the shifting of an ordinary starting lever backwards or forwards from a central position. When the lever is in the central position no current is supplied to the field magnets of the continuous-current generator from the separate exciting machine. When the lever is moved more or less forward, more or less current in one direction is supplied to these magnets. A greater or less electromotive force is then produced in the armature, which, as before mentioned, rotates at a constant speed. If the hoisting motor is at rest, and so, in spite of being constantly excited, is producing no electromotive force, the generator electromotive force drives a current through the motor armature, producing a torque which, if large enough, starts the motor. The back electromotive force then produced tends to reduce the current and the torque, and to keep this latter at a constant value more and more current has to be sent through the generator field windings, this being effected by a further movement of the regulating lever.

A backward movement of the lever will at any moment reduce or reverse this torque, the latter bringing into play the regenerative action above referred to.

It will be seen that this method of control is of the utmost simplicity, and that it has the very great advantage of being regenerative in its action.

As regards the question of simplicity, the main points to be noted are: (1) That the electrical operations carried out by the movement of the control lever are the cutting in or out of the resistances in the circuit of the generator field magnets and the reversing of the connections with the exciter busbars; (2) that a movement of the lever in one direction tends to increase the torque of the hoisting motor in a di-

rection which may be called the positive direction of rotation, while a movement of the lever in the opposite direction tends to decrease the torque of the hoisting motor in the positive direction of rotation. If it is borne in mind that a torque in the positive direction when decreased to a value below zero becomes a torque in the negative direction, the above statement covers the whole of the relation between the movement of the regulating lever and the torque of the winding motor. It must, however, not be forgotten that a variation in speed, with a fixed position of the control lever, will cause a change in current and torque owing to the variation of the electromotive force produced by the constantly excited hoisting motor. This, of course, happens when the torque applied is either more than sufficient or less than sufficient to produce motion with uniform velocity. (3) That to a definite torque corresponds a definite value of the current flowing in the armatures, so that a polarized ammeter always affords an indication of the amount and direction of the torque. The torque so indicated is entirely independent of the speed at the moment, and the curve showing the relation between current and torque is a straight line if armature reaction is small enough to be neglected. The ammeter consequently can be, and in practice actually is, used by the engine-driver as a torque indicator, though it is not known by this name.

Although it is a point that is not being dealt with at present, it should be noted in passing that regenerative action is inherent in this method of control, and accordingly introduces no complications of any sort. In fact, if the regenerative action becomes inoperative or partially inoperative, as, for instance, in the case of the opening of the main circuit-breaker forming the connection to the supply mains, the method of control becomes unworkable as regards both driving and electrical braking.

With all continuous-current machinery the question of speed depends upon the voltage, which may be regulated in two ways. One way is that described above, by regulating the field strength, and the other is by absorbing more or less of the available voltage of supply in resistances. The wastefulness of the latter method, usually called the rheostatic method of control, is obvious and well known. In simplicity it compares on equal terms with the other, the electrical operations being identical, but as they affect the main instead of a field circuit, the scale on which they are conducted is larger.

With induction motors the only simple method of speed control, that of inserting resistance into the secondary circuit, is comparable when hoisting, so far as wastefulness is concerned, with the rheostatic control of continuous-current motors. In each case a definite torque at a speed between full speed and zero can only be secured by using the full power that would correspond to it at full speed. In the case of the continuous-current motor the difference between the full speed power and that corresponding to the speed desired is dissipated as heat in a series resistance; in the induction motor the difference appears as electrical output of the secondary member of the motor, that is, usually, the rotor, and is then ordinarily converted into heat in an external resistance.

Both in simplicity of operation and wastefulness, therefore, the induction motor and the rheostatically controlled continuous-current motor are on a level when hoisting at speeds below full speed.

When lowering loads at speeds below full speed the continuous-current motor can be operated with rheostatic control in two ways. The more economical is to cut off the supply of current to the motor armature and allow the motor to operate as a generator, which it is capable of doing at all speeds, absorbing in the resistance the whole of the power generated. The power derived from the mains during this operation is only that required for excitation. The complication, however, of switching off the mains from the motor armature and short-circuiting it through the resistance is introduced, and it becomes necessary to reverse both these movements to bring the motor absolutely and steadily to rest by electrical means.

The alternative method, more wasteful in power, but simpler in operation, is to leave the motor connected to the mains, to take from them the current corresponding to the desired motor torque, and to absorb in the resistance both the power represented by this current and that produced by the hoisting motor, now operating as a generator driven by the descending load. Since at full lowering speed the winding motor voltage (if the machine may still be called a motor when operating as a generator) will be about equal to the line voltage, the resistance has to be large enough to absorb about twice the full normal output of the motor.

The action of the induction motor when lowering loads may be considered as almost exactly similar to the latter of the above described actions of the rheostatically controlled continuous-current motor. It is equally simple and equally wasteful.

Both for lifting and lowering loads, therefore, it may be said that the electrical operations involved are the cutting in and out of resistances in the circuit of the generator fields and reversing them, so exactly the same operations in the motor-armature circuit will give complete rheostatic control of a continuous-current motor, and the cutting in and out of resistances in the secondary circuit of an induction motor combined with the reversing of the primary connections will give an equally simple method of induction-motor control. Equally simple methods of hoisting-engine motor control being therefore available, it follows that the direct induction-motor drive must usually have by far the best over-all simplicity, as practically all heavy transmission work is done on the three-phase system, and consequently whenever continuous-current motors are employed some form of converter is a necessary additional complication.

New Haven's Cos Cob Plant to Be Enlarged.

To the present plant of the New York, New Haven & Hartford Railroad Company at Cos Cob there is to be added an extension providing for four 4,000-kilowatt generators, of which three will be installed immediately. The capacity of the power house will thus soon be more than doubled.

The enlarged power plant will be used not only for operation on the main system, between Stamford and New York, but also for the Harlem division, for the Stamford Railway System, for the New York, Westchester & Boston, which is to be partly opened next autumn, for the Mamaroneck, White Plains & Tarrytown line, and for electric lighting in Greenwich. Sufficient power will also be supplied by the new plant for electrical service eastward upon the main line to a point half way between Cos Cob and New Haven.

ELECTRICAL REFRIGERATION IN THE ICE-CREAM BUSINESS.

BY R. L. LLOYD.

There is no application of artificial refrigeration that will show greater savings over the use of ice, either natural or artificial, than are experienced in the manufacture of ice cream. To the thinking individual this is more or less evident on account of the very low temperatures required, and the necessity for using an additional agent, *viz.*, salt, with the ice to obtain the desired result.

The use of ice cream is ever becoming more and more popular and its consumption is constantly on the increase. Winter as well as summer now has its regular demand for this popular American dish, and many of the progressive ice-cream makers are installing refrigerating machines, not only to economize but also to save labor and to avoid much of the wet, disagreeable part of the work.

Practice, prices and conditions must necessarily vary over a large country like the United States, but let us assume some figures as average and make a comparison between the use of an ice-and-salt mixture and a motor-driven refrigerating machine in an ice-cream plant of a size suitable for a retail dealer.

According to Hart, twelve gallons of ice cream per hour per ton of machine capacity is a fair figure for making and hardening. Assume ice costs $4.00 per ton: salt 0.5 cent per pound; a rate of six cents for electric power; and an average use of 400 pounds of ice and 100 pounds of salt per 100 quarts of ice cream, made, hardened and disposed of each twenty-four hours.

400 pounds of ice at 20 cents per 100 pounds $0.80
100 pounds of salt at 50 cents per 100 pounds 0.50

Salt and ice per 100 quarts..... $1.30
Salt and ice per 400 quarts..... $5.20

A two-ton machine with a five-horsepower motor would be the proper equipment for this size business and would probably be operated eight or ten hours per day, for although four hours only would be occupied in making the ice cream, additional running would be necessary to keep the brine cold for the hardening and keeping.

The fixed charges on a plant costing $1,800 should be well under $350 per year. But we will allow $1.00 per day for fixed charges, oil, waste, etc. The actual power used will be three kilowatts.

30 kilowatt-hours at 6 cents..... $1.80
Fixed charges, etc. 1.00

Total cost for 400 quarts..... $2.80
Saving over ice and salt..... $2.40

This is a saving over ice and salt of forty-six per cent.

Reducing this to smaller quantities we have as follows:

Cost of ice and salt per quart of ice cream ..... 1.3 cents.
Cost of electric power to refrigerate one quart of ice cream. 0.45 cent.

The above figures are conservative and would show similarly to the advantage of the wholesale maker; for although the proportion of ice per 100 quarts would be slightly reduced, so also would the rate for electricity when purchased in larger quantity, and so also would the proportion of fixed charges.

The ordinary method for the hardening process used by the retail dealer is the brine tank arranged to accommodate the requisite number of twenty and forty-quart cans in a double row. A perforated false lid keeps the cans in their proper positions, or individual collars on perforated cylinders may be used. The latter are not advisable on account of hindering to some extent, freedom of movement of the brine. Direct-expansion piping is arranged within this cabinet around or between the cans and sufficient circulation is obtained by gravity and convection resulting from the difference of temperature. From zero to six or eight degrees Fahrenheit is the desired point reached.

Sometimes this same cabinet is drawn on for the brine used for circulation through the freezer while making the ice cream. It is then passed through a brine cooler in order to rapidly reduce its temperature and make it more effective against the relatively high temperature of the ice-cream mixture.

The preferable method is to have a second and much smaller tank of brine for this purpose alone, leaving the hardening tank to more uniformly take care of its own branch of the work. In either case the brine cooler is used, but with the latter method, more positive and ready results are obtained.

With the wholesaler, the dry-hardening method is considered the best engineering practice today. For this purpose a well insulated and vestibuled room is arranged with shelves on which are placed the cans of freshly made soft ice cream. A loft or bunker above the room is filled with direct-expansion ammonia piping and a revolving fan keeps the air constantly circulating among the pipes, down over the cans and up again at the other end of the room. By this method results are quickly secured, the ice cream is rapidly hardened and there is no large body of brine to either be cooled down on starting the machine or to heat up after shutting the machine down. This is the condition desired by the wholesaler whose chief aim is to pass his product on just as soon as possible and not to carry stock over from day to day.

Fig. 1 illustrates a plant of this character. On the left is seen one end of the hardening room with a small door for passing in the cans. It is arranged on the plan above mentioned, but is double, *i. e.*, there are two rooms, one on either side of the vestibule, or entry passage. In the center of the picture is the refrigerating machine, a twin York compressor of thirty-ton rating. The sixty-horsepower motor in the foreground drives through the medium of a silent chain. This plant is an excellent example of modern engineering, but has not been in operation sufficiently long to supply any useful data.

The attention will next be directed toward the other extreme of size with the examination of some retail dealers' plants.

An ice-cream maker and confectioner installed a two-ton Larsen-Baker refrigerating machine to make and harden ice cream, cool a soda fountain and drinking water, cool a chocolate candy cabinet and refrigerate a food box for his family use. Brine from the main tank in the cellar is circulated by a small triplex pump with a capacity of ten gallons per minute, to the various equipments to be cooled. This is a brine system. All of the ammonia piping is located in the tank just mentioned and the cooling work is accomplished by the circulated brine. Valves control the various pipe leads and any of them can be shut off when no further refrigeration is required on that particular line. One five-horsepower motor drives both machine and pump by means of a countershaft and a tight and a loose pulley. After the brine in

the tank has been cooled down to the desired point, the pump is started and is then kept running, for the balance of the day, with the machine.

Another five-horsepower motor drives the candy factory and ice-cream machine. No ice is now required for any purpose whatever as no ice cream is sent out in tubs.

Present electric power bills for all purposes are about equal to former bills for ice and salt. Labor is very much lightened and at a minimum, and conditions attending same are vastly improved. From 15,000 to 18,000 kilowatt-hours are used per year.

Another case of interest concerns an ice-cream parlor handling from 100 to 200 quarts per day, which is all made outside and delivered in a fairly hardened state, ready for serving. A one-ton refrigerating machine and a three-horsepower motor do the work of keeping the cream in proper condition. On arrival, the cans are placed in the serving cabinet which is of the type described above with ammonia piping and still brine. A constant and low temperature is maintained, insuring a superior and uniform condition for the ice-cream. The labor and annoyance of re-icing are avoided, a much appreciated desideratum in a store of this character. The proprietor spends almost his entire time at another store where the manufacturing is done, leaving this one in charge of women and one boy. The expense of machine operation has amounted to about $300 per year. This is less than ice and salt would have cost, and the saving in labor has been considerable, probably equalling the services of one man. The average use per year reaches 5,200 kilowatt-hours. In summer the machine runs ten hours per day, while in winter five hours of operation are sufficient.

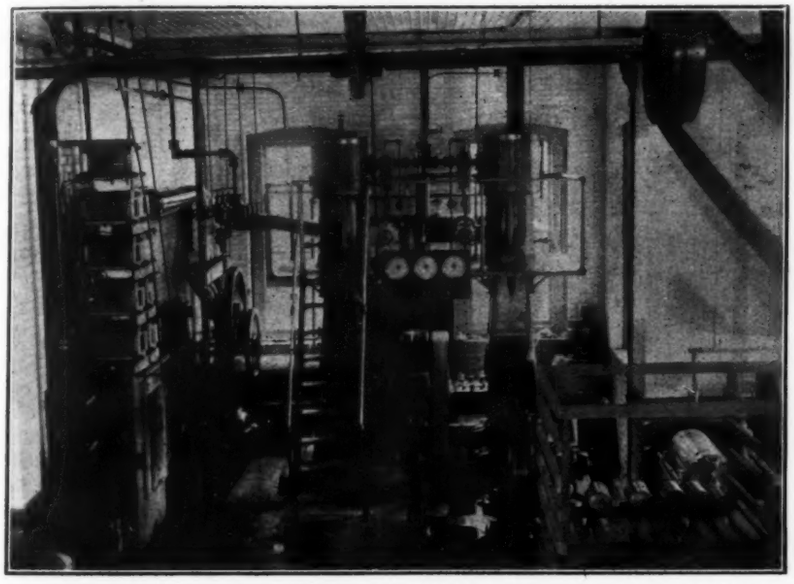


FIG. 1.—FIFTEEN-TON TWIN AMMONIA COMPRESSORS DRIVEN BY SIXTY-HORSEPOWER VARIABLE-SPEED INDUCTION MOTOR.

The Use of Electricity on Italian Railways.

The report of the Italian State Railways for the year 1909 contains some interesting information with regard to the electrified steam lines and to the use of electricity on steam cars. The Busalla-Pontedecimo section of the Genoa-Busalla line was completed in January, 1910, and after a number of experimental runs regular train service was instituted in July with Westinghouse locomotives. The train weights were gradually raised to 400 metric tons and the speed to forty-five kilometers per hour (27.9 miles per hour). Progress is reported in the electrification of the Bardonecchia-Modane section of the Mont Cenis Railway. A contract was made with the municipality of Turin whereby the latter will furnish 3,000 kilowatts for three years and, if necessary, for four years to the line named. Negotiations are under way looking to the purchase of power in case the Turin-Pinerollo line is electrified, which has been considered for single-phase operation. The Lecco-Calolzio Railway was also placed in service during the year.

Rapid Increase of Electric Power in South African Mines.

The annual report of the government mining engineer of Transvaal, South Africa, gives some interesting facts relative to the increased use of electricity on the Witwaterstrand.

There was a large increase in the use of electrically-driven machinery in connection with the mines, the horsepower of motors having risen during the past year from 76,299 to 108,354. Owing to the fact that the electrification of the power supply of a majority of the mines is now rapidly going ahead, this total will be largely increased during the present year. This scheme contemplates not only the employment of motor-driven compressors for supplying compressed air, but motors will also be used for hoisting and pumping and in a majority of cases for the mill drive. The induction motor has been chosen by many of the mines for hoisting purposes, this being generally the case when it was necessary to convert an existing steam hoist, but it is understood the Ward-Leonard system has been adopted in most instances where a completely new hoisting plant was required.

The rated capacity of the stations now in process of construction by the Victoria Falls Power Company and the Rand Mines Power Supply Company is: Brakpan, 12,000 kilowatts; Simmer Pan, 18,000 kilowatts; Driehoek, 3,000 kilowatts; Rosherville, 50,000 kilowatts; Vereeniging, 40,000 kilowatts. The first three are practically completed, and the Rosherville station is under construction. In addition to the supply available from these companies, several groups of mines have their own electric power stations either in process of construction or enlargement.

Storage-Battery Car on Long Island.

An Edison-Busch storage-battery car is being tried out on the Bushwick branch of the Long Island Railroad. It will be given a month's trial, but so far has been quite satisfactory. The car is designed for 26 passengers, but has carried 59 up a steep grade without difficulty. The battery charge is sufficient for 100 miles, and is renewed every day. The speed attained is 22 miles per hour.

It is not planned to substitute these cars for the trolley system already installed but to use them on future extensions.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

PHILADELPHIA COMPANY.

The Philadelphia Company has issued its report for the year ended March 31, 1911. The income account, not including the returns of affiliated companies, compares as follows:

	1911	1910
Earnings, gas	$6,215,421	$6,032,795
Earnings, oil, etc.	323,419	578,128
Total earnings	6,538,840	6,610,933
Expenses and taxes	2,513,910	2,460,152
Net earnings	4,024,930	4,150,781
Other income	2,505,775	2,352,004
Total income	6,530,705	6,502,785
Charges, rents, etc.	1,266,268	1,328,644
Balance	5,264,437	5,174,141
Improvements, betterments, etc.	1,633,827	1,042,797
Surplus	*3,630,610	4,131,344
Previous surplus	4,610,779	3,336,696
Total surplus	8,241,389	7,468,040
Preferred dividends	300,000	300,000
Common dividends	2,558,407	2,035,794
Con. Gas Guar., etc.	79,760	80,000
Miscellaneous adjustments	†241,433	441,466
Profit and loss surplus	5,062,594	4,610,780

*Equal to five per cent on the preferred stock and 8.63 per cent on the $38,561,000 common stock as compared with five per cent for preferred and 10.64 per cent on the $36,000,000 common stock last year.

†Discount taxes and expense in connection with the sale of securities.

The combined income account of the Philadelphia Company and affiliated companies, not including the Allegheny Heating Company, for the year ended March 31, 1911, compares as follows:

	1911	1910
Gross	$20,140,035	$19,147,517
Expenses and taxes	10,918,214	9,933,336
Net	9,221,821	9,214,180
Other income	277,586	327,237
Total income	9,499,408	9,541,418
Deductions	1,466,973	1,473,509
Balance	8,032,434	8,067,909
Fixed charges	3,411,719	3,418,668
Balance	4,620,714	4,649,241
Improvements, betterments, etc.	1,905,751	1,424,217
Surplus	2,714,963	3,225,023
Notes retired	40,000	40,000
Balance	2,674,963	3,185,023
Preferred dividends	382,961	382,961
Surplus for year	2,292,002	2,802,062

MASSACHUSETTS ELECTRIC COMPANIES.

The report of the Massachusetts Electric Companies for the quarter and six months ended March 31, 1911, compares as follows:

March:	1911	1910
Gross	$ 1,830,361	$ 1,767,153
Expenses	1,250,983	1,256,599
Net	579,378	510,554
Charges and taxes	459,754	470,532
Surplus	119,624	40,022
Oct. 1 to March 31:		
Gross	$ 3,846,132	$ 3,688,227
Expenses	2,712,587	2,585,500
Net	1,133,545	1,102,727
Charges and taxes	916,583	915,187
Surplus	216,961	187,540

PHILADELPHIA COMPANY.

The report of the Philadelphia Company for the month of March and twelve months ended March 31, 1911, compares as follows:

	1911	1910
March gross	$ 1,884,369	$ 1,916,662
Expenses and taxes	1,084,509	974,350
March net	809,860	942,312
Twelve months gross	20,869,542	19,868,997
Expenses and taxes	11,707,188	11,192,072
Twelve months net	9,162,356	8,676,925

AMERICAN LIGHT AND TRACTION.

The American Light & Traction Company has issued a report for the twelve months ended March 31, 1911, which compares as follows:

	1911.	1910.
Gross earnings	$3,933,091	$3,463,580
Expenses	119,521	107,445
Net earnings	3,813,569	3,356,135
Previous surplus	6,243,814	6,131,563
Total surplus	10,057,384	9,487,698
Cash and stock dividends	2,899,003	3,243,884
Profit and loss surplus	7,158,380	6,243,814

ILLINOIS TRACTION COMPANY.

The Illinois Traction Company has issued its full pamphlet report covering the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Total gross earnings	$6,218,037	$5,363,383
Operating expenses and taxes	3,665,627	3,063,491
Net earnings	2,552,409	2,299,892
Less net earnings of Des Moines and Topeka properties prior to purchase	54,182	372,628
Net revenue Illinois Traction	2,498,226	1,927,263
Charges, etc.	1,536,687	1,250,429
Surplus	961,539	676,834
Preferred dividends	273,286	259,146
Surplus	688,253	417,688

EDISON ELECTRIC ILLUMINATING OF BOSTON.

The report of the Edison Electric Illuminating Company of Boston, for the month of April shows an increase in gross earnings of $45,729 and in net of $32,594. Following are the figures:

	1911	Increase
Gross	$ 439,329	$ 45,729
Expenses	184,780	13,135
Net	$ 254,549	$ 32,594
Ten months—		
Gross	$4,401,606	$471,260
Expenses	1,862,267	82,810
Net	$2,599,339	$388,450

KEYSTONE TELEPHONE COMPANY.

The Keystone Telephone Company report for the month of April and ten months ended April 30, 1911, compares as follows:

	1911.	1910.
April gross	$ 98,986	$ 95,690
Expenses and taxes	49,528	46,152
April net	49,458	49,538
Charges, etc.	24,547	24,705
April surplus	24,911	24,833
Ten months gross	957,903	931,352
Expenses and taxes	477,427	466,980
Ten months net	480,476	464,372
Charges, etc.	244,672	252,969
Ten months surplus	235,804	211,403

COLUMBIA GAS & ELECTRIC.

The Columbia Gas & Electric Company reports for the year ended December 31, 1910, as follows:

Sales of natural gas	$1,021,763
Interest and dividends of subsidiary companies	1,044,422
Proportion of undisturbed earnings of subsidiary companies	246,069
Total earnings	2,312,254
General expenses, salaries, etc.	112,608
Interest and taxes	80,654
Rental of Kentucky properties	446,522
Pipe line rental	499,076
Gas field rentals and royalties	64,567
Natural gas purchased	234,136
Interest on bonds	781,575
Total deductions	2,219,139
Balance to surplus	93,115

INTERBOROUGH RAPID TRANSIT.

The earnings of the Interborough Rapid Transit Company for the month of March and nine months ended March 31, 1911, compare as follows:

	1911.	1910.
Gross operating revenue	$ 2,742,785	$ 2,678,216
Operating expenses	1,123,817	982,868
Net operating revenue	1,618,969	1,695,348
Taxes	162,887	152,791
Income from operating	1,456,081	1,542,557
Other income	26,049	31,125
Total income	1,482,130	1,573,681
Int., rents, etc., including Manhattan guar.	889,316	883,849
Net corporate income	592,814	689,832
Passengers carried	53,347,345	52,076,237
July 1-March 31:		
Gross operating revenue	$ 22,122,895	$ 21,530,079
Operating expenses	9,166,818	8,211,487
Net operating revenue	12,956,078	13,318,592
Taxes	1,393,206	1,272,845
Income from operating	11,562,871	12,045,746
Other income	251,660	320,056
Total income	11,814,531	12,365,802
Rentals, etc., including Manhattan guarantee	7,986,298	7,912,715
Net corporate income	3,828,234	4,453,087
Dividends	2,362,500	2,362,500
Surplus	1,465,734	2,090,587
Passengers carried	429,417,352	417,969,694

The increase in operating expenses is largely due to extraordinary expenditures, the result of changes in subway equipment made necessary in connection with the operation of ten-car express and six-car local trains.

CITIES SERVICE COMPANY.

The Cities Service Company reports for the seven months ending April 30, 1911, as follows:

Earnings on stock of subsidiary companies	$548,738
Miscellaneous earnings	19,579
Gross earnings	$568,317
Expenses	14,914
Net earnings	$553,402
Dividends on preferred	285,530
Dividends on common	82,419
Surplus	$185,453

HUDSON & MANHATTAN.

The Hudson & Manhattan Railroad Company report for the month of April compares as follows:

	1911.	1910.
Gross revenue, all sources	$385,945	$326,188
Expenses and taxes	172,438	133,582
Gross income	213,507	192,606
Interest on bonds outstanding	241,610	245,249
Less interest charges to construction	54,074	74,310
Balance	188,536	170,938
Other charges	23,867	20,426
*Total deductions	212,403	191,364
Surplus	1,103	1,242

*Being fixed charges applicable against that portion of the property employed in present operations.

From July 1 to April 30 gross revenue amounted to $3,560,709; gross income after expenses and taxes, $1,936,638; deficit after charges, $58,088.

SYRACUSE RAPID TRANSIT.

The report of the Syracuse Rapid Transit Railway Company for the quarter ended March 31, 1911, compares as follows:

	1911.	1910.
Operating revenue	$381,971	$358,854
Operating expenses	256,666	239,073
Net revenue from operation	125,305	119,780
Taxes accrued	17,319	18,088
Operating income	107,985	101,691
Deductions from gross	81,204	77,802
Net corporation income	26,782	23,889

SCHENECTADY RAILWAY.

The report of the Schenectady Railway Company, Schenectady, N. Y., for the quarter ended March 31, 1911, compares as follows:

	1911	1910
Total operating revenue	$266,244	$251,511
Total operating expense	164,314	171,958
Net operating revenue	101,929	79,553
Taxes accrued	13,959	11,933
Operating income	87,970	67,620
Non-operating income	3,109	3,064
Gross income	91,079	70,685
Total deductions from gross income	23,547	25,023
Net corporate income	67,531	45,661

UNITED TRACTION OF ALBANY.

The report of United Traction Company (Albany and Troy) for the quarter ended March 31, 1911, compares as follows:

	1911	1910
Total operating revenue	$537,234	$487,144
Total operating expense	364,521	331,879
Net operating revenue	172,713	155,265
Taxes accrued	36,000	33,000
Operating income	136,713	122,265
Other income	50,951	51,315
Gross income	187,665	173,580
Charges	102,860	95,863
Net corporate income	84,804	77,716

HUDSON VALLEY RAILWAY COMPANY.

The report of the Hudson Valley Railway Company, for the quarter ended March 31, 1911, compares as follows:

	1911	1910
Total operating revenue	$129,972	$118,985
Total operating expense	99,247	114,382
Net operating revenue	30,725	4,603
Taxes accrued	6,750	5,872
Operating income	23,975	*1,269
Non-operating income	938	900
Gross income	24,914	*369
Charges	60,755	55,299
Deficit	35,841	55,668

*Deficit.

CUMBERLAND TELEPHONE.

The report of the Cumberland Telephone & Telegraph Company, for the month of March and three months ended March 31, 1911, compares as follows:

	1911	1910
March gross	$ 598,511	$ 568,336
Expenses	349,744	320,729
March net	248,766	247,607
Charges and taxes	50,644	47,523
March surplus	198,122	200,083
Three months' gross	$ 1,778,677	$ 1,665,597
Expenses	1,036,915	952,858
Three months' net	741,762	712,740
Charges and taxes	154,836	142,863
Three months' surplus	586,925	569,876

AURORA, ELGIN & CHICAGO.

The report of the Aurora, Elgin & Chicago Railroad Company for the month of March and nine months ended March 31, 1911, compares as follows:

	1911.	1910.
March gross	$ 122,679	$ 118,708
Expenses	74,913	69,443
March net	47,766	49,265
Charges and taxes	35,948	32,263
March surplus	11,813	17,002
Nine months gross	1,290,629	1,181,898
Expenses	744,151	655,610
Nine months net	546,478	526,288
Charges and taxes	308,693	273,955
Nine months surplus	237,784	252,533

KINGS COUNTY ELECTRIC.

The report of the Kings County Electric Light & Power Company for the month of April shows surplus of $76,980, against $75,551. Following are the figures, with comparisons:

	1911.	1910.
Gross	$ 369,918	$ 342,413
Expenses	186,973	163,260
Net	182,945	179,153
Charges and depreciation	195,965	103,602
Surplus	76,980	75,551
Four months gross	1,588,796	1,414,053
Expenses	766,294	655,029
Net	822,502	759,033
Charges and depreciation	448,933	406,252
Surplus	373,569	352,781

AMERICAN LIGHT & TRACTION.

The report of the American Light & Traction Company for the month of April and four months ended April 30, 1911, compares as follows:

	1911.	1910.
April gross	$320,329	$274,605
Expenses	10,109	9,423
April net	310,220	265,182
Four months gross	1,387,041	1,240,777
Expenses	37,149	36,631
Four months net	1,349,891	1,204,146

BINGHAMTON LIGHT, HEAT & POWER COMPANY.

The Binghamton Light, Heat & Power Company reports the following income account for the quarter ended March 31:

	1911.	Increase.
Gross income	$44,179	$4,475
Net income	20,169	3,115
Balance available for sinking fund, dividends, etc	13,919	3,115

Carolina Power Purchase.

The Carolina Light & Power Company, which recently took over the Buckhorn Falls Power Company, the Belwitt Falls and other electric power generating plants, has purchased the Standard Gas & Electric Company at Raleigh and now controls the entire light system of the State capital.

The company has just awarded contracts for steel towers, transmission wires, and other material necessary to equip the line from the Blewitt Falls plant to Raleigh. Work on the great transformer station near Raleigh has started and it is predicted that the work there will be completed by the time the Blewitt Falls power station is ready to turn on the power. Already some $3,000,000 have been spent on the works at Blewitt Falls, and the men in charge now state that the generators will be in operation January 1, 1912.

Proposals for Telephones.

An American foreign sales manager writes to the Bureau of Manufactures that one of his correspondents in the Philippine Islands wishes to receive prices on telephone installations. Details will be supplied by the Bureau of Manufacturers. In writing for information reference should be made to File No. 6726.

AMONG THE CONTRACTORS AND SUPPLY MEN

H. S. KAUFFMAN, Bloomsburg, Pa., received the contract for wiring the court house at Bloomsburg.

R. A. McLAUGHLIN has opened an electrical supply house in Galesburg, Ill. He will also do a general electrical contracting business there.

THE MOBRIDGE ELECTRIC COMPANY, Mobridge, S. D., only recently incorporated, and has up to date received a number of good wiring contracts.

LEITHNER & WISHAR, Rock Island, Ill., have entered into the electrical contracting field, and will make a specialty of interior wiring and fixture work.

THE THOMAS DAY COMPANY, San Francisco, Cal., was awarded the contract for furnishing and installing the lighting fixtures in the Federal Building in Sacramento, Cal.

THE CITIZENS' ELECTRICAL COMPANY, Des Moines, Iowa, has been awarded the contract for wiring the Y. M. C. A. Building at Des Moines. The amount of the bid was about $3,000.

THE BAILEY ELECTRICAL COMPANY, Cincinnati, O., was awarded the contract for wiring the two new school buildings at Toledo, O. The company's bid for furnishing the supplies and doing the work was $31,780.

THE W. E. CARTER ELECTRIC COMPANY, Atlanta, Ga., was awarded the contract for the electric lighting fixtures for eight floors of the new Georgian Terrace Hotel in Atlanta. L. L. Shivers is vice-president and general manager of the company.

HANSON AND ALDERSON, 612 North Avers Avenue, Chicago, Ill., have entered the electrical contracting business, and are prepared to handle contracts of any size. Mr. Alderson, the manager, was formerly installation foreman for the Chicago Telephone Company.

THE TROY ELECTRIC COMPANY, Troy, N. Y., has moved its offices and salesrooms to the Murray Building at State and River Streets. The Troy Electric Company is practically the successor of the E. G. Bernard Company, and is continuing in the electrical contracting business, carrying a large line of all kinds of electrical supplies and electrical repairs.

New Electrical and Mechanical Apparatus and Appliances.

New Line-Disconnecting Fuse Switch.

A new line-disconnecting fuse switch, which it is believed will be of considerable interest to electric light and power engineers, has just been placed upon the market. Fig. 1 shows the box ready to be mounted on the cross arm, where it is easily and quickly attached by hooking it on by the hangers provided, in the same manner as a transformer. Fig. 2 shows the box opened with all parts exposed. Fig. 3 shows the carrier and fuse removed from the box and gives a good idea of their details.

It will be noticed that in this device use is made of the expulsion-type fuse, which is at once effective and easily renewed at a low cost. The expulsion fuse is mounted on a carrier of strong non-conducting material provided with knife-blade contacts, permitting the opening of a circuit in a manner similar to a high-potential disconnecting switch.

By the aid of a hinged stud located beyond the contact, the switch member carrying the expulsion fuse is bodily removable from the device, permitting the changing or renewal of fuses with absolute safety, as shown in Fig. 3.

Line connections made to the knife-blade contacts through heavy extra-flexible highly insulated cable provid-

FIG. 1—FUSE-SWITCH BOX.

ed with large porcelain bushings are easily removable should the wire part from any cause. Bushings will prevent leakage with bare wire in heavy precipitation. In actual test 19,000 volts was used before flashover occurred.

The case is made of cast iron of a design requiring no gaskets to be weatherproof. The door and case are arranged with hinges and latch lugs on each side made interchangeable, thus permitting the door to be swung either to the right or to the left in order to facilitate access to the switch and fuse. The specially designed latch and the arrangement of the switch member permits the opening of the case and the switch and the electrical disconnection

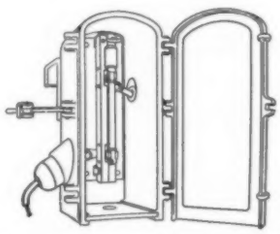


FIG. 2—FUSE-SWITCH BOX OPEN.

of the fuse without touching the device with the hands.

The complete device is exceptionally easy to install, the case being provided with hooks for the cross arm, no bolts or screws being necessary. Electrical connection is made by simply connecting the line wire to the wires furnished as a part of the device. Danger incident to the iron case being electrically charged is eliminated by mounting the contacts on an insulating base and providing the connecting wires with heavy porcelain bushings and equipping the case with a removable transite bottom, through which the expulsion fuse discharges.

The Matthews fuse switch possesses the important advantage of combining in one article a thoroughly reliable and desirable type of high-voltage fuse with an improved disconnecting switch, permititng the operation of the device as a whole with a large factor of safety.

The advantage of this fuse switch is that it has a positive make-and-break contact constructed in such a manner that it cannot get out of alinement. The carrier is pivotly mounted on a standard and so designed that when the fuse blade is swung out at an angle, it immediately becomes disconnected from the electrically charged parts and permits the removal of the blade and fuse cartridge without the use of tools of any description. This permits the operator, troubleman or lineman to swing over to the end of the pole, stand on his spurs and hold himself in a safe and secure position without coming in contact with wires or transmission devices of any description. It permits him to change the fuse in the cartridge and place the blade back in position without the aid of special tools except a wooden handle with a hook on the end. This leaves the man in such a position that in the event of the fuse exploding he cannot be injured.

In addition to the above, this fuse does not permit a recurrent surge action in the balance of the system, because the metallic gas path is absolutely destroyed by the rehabilitation of the air in the air chamber.

The Matthews fuse switch has a capacity of 75 amperes on voltages up to 6,600. Special designs can be easily worked out for higher voltages and greater amperages.

The Union Electric Light & Power Company, of St. Louis, has over 100 of these swicthes installed and are placing them all over its system.

Some of the advantages claimed for this switch are: it combines in one device two very important and desirable pieces of apparatus required in the operation of overhead primary lines, the fuse block and the primary switch; it is a self-indicating trouble finder; it eliminates the trouble, damage and danger caused by the recurrent surge of the line when fuse blocks are used; it can be employed as line disconnect-

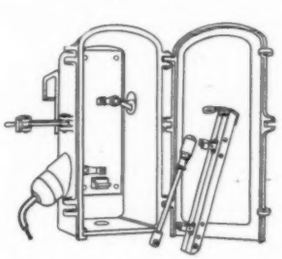


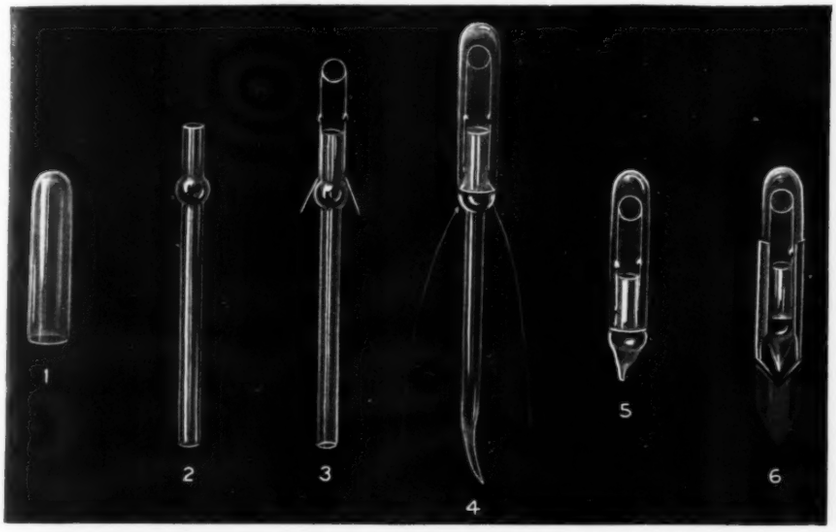
FIG. 3—CARRIER AND FUSE REMOVED.

ing switch, cribbing switch or branch-main switch, also as a limit switch on consumers' connections where there is any question as to whether they use more energy than that for which they contracted; reasonable first cost, exceptionaly low cost of installation and low cost of maintenance.

The Matthews fuse switch is being placed on the market by the firm of W. N. Matthews & Brother, 216 North Second Street, St. Louis, Mo.

Manufacturing Telephone-Switchboard Lamps.

The story of the manufacture of the tiny lamps that glow on telephone switchboards as subscribers pick up their receivers is one of unusual interest. To make this product efficient and satisfactory has been a problem for the manufacturers. To turn out these lamps in large quantities is a task that involves extremely delicate operations. The carbon filament used in the lamp has a diameter equal to that of the human hair, and when this and the other unusual conditions are taken into account, it may well be said that the efforts of the manufacturers have been highly successful.



SWITCHBOARD LAMP IN PROCESS OF MANUFACTURE.

To produce a lamp that will give service for the greatest length of time has been the object of much of the development of types. To determine to what extend this has been accomplished, some interesting tests have been carried on at the Hawthorne plant of the Western Electric Company. The lamps under test were those which have been adopted as standard for telephone switchboard use.

Life tests regularly carried on by this company show that the lamps have an extremely long life when burned at usual voltages. In fact, the usual 1,000-hour life tests show very few unsatisfactory lamps. In order to determine how long these lamps would burn, one of the test lots has been allowed to burn continuously since 1903. No change from the original condition of the lamps, so far as a satisfactory signal is concerned, has occurred during the more than 50,000 hours in which the lamps have burned. Intermittent lighting up of the lamp, similar to that given in switchboard service, in no way shortens the life of the lamp, even when the flashing has occurred for over a million times.

The wonderful results in quality which have been secured have been possible on account of the large output in product, permitting special machines and processes to be used to advantage. The capacity of the Hawthorne switchboard-lamp factories now permits of a yearly output of two million lamps.

Early in the development of the lamps the size becomes fixed with dimensions of five-sixteenths inch in diameter and one and three-fourths inches in length. The standard line lamp is designed to give a satisfactory signal on twenty-four volts, consuming slightly less than one-tenth of an ampere. The problem of placing a filament with a resistance of 250 ohms or more in a glass globe .25 inch in diameter was well nigh impossible in the early days, but improved methods in manufacture have made it possible to place filaments with a resistance even as high as 1,000 ohms within the standard dimensions of switchboard lamps.

A metal filament such as tungsten or tantalum being of much lower resistance than the carbon is not ideal for the voltages and currents now considered standard for telephone work. Accordingly the development of the filament has been along the lines considered standard for carbon filament.

The chemist takes cotton or filter paper and dissolves it in a strong solution of zinc chloride, one of the most corrosive and troublesome liquids known. The result is a solution very similar in appearance to glucose, but full of little air bubbles, every one of which must be removed or the filament will not be satisfactory.

Cotton or filter paper is ordinarily called in a lamp factory cellulose, and these are two very pure forms of this wonderful material. After it has been dissolved in the zinc chloride it is called amyloid, and when it is squirted through a small die or tube into the alcohol it forms a thread, not so very strong, but of wonderful properties. The alcohol removes the zinc chloride, precipitates and hardens the cellulose. The filament is squirted into a large round glass jar and many feet are squirted into the form of a ring on the bottom of the jar.

This ring increases in height until there are at times thousands of feet of the filament in each jar. It is a difficult problem to remove this filament, dry and stretch it without tangling. Amyloid in this form has the property of shrinking almost indefinitely in every direction, and in order to make it suitable as to uniformity in lamps careful drying must be adopted. The average size of the human hair is about .002 inch in diameter, and this is just the size of the filament thread after being dried and stretched. Only girls who have perfect eyesight and delicate hands can handle this work at all satisfactorily, and even then the difficulty is very great.

This thread looks very much like a violin string, although it is not nearly as strong, and it is wound in suitable shape on carbon blocks preparatory to changing of the cellulose thread to a pure-carbon filament. The little blocks of carbon with their load of threads properly attached are then placed in a brass-moulder's graphite crucible and packed thoroughly with pure powdered carbon. The cover of the crucible is securely fastened on and the crucible is placed in a gas or oil furnace, the temperature of which must reach the highest point that the crucible will stand.

The little filament, being away from all air, changes over to carbon of a most durable kind, very hard and elastic. It is tested for quality, resistance and size before being sent to the oper-

ators, who mount the filaments on the stems.

The electrical resistance of the lamps must be within the predetermined limits, and the uniformity of the filament from end to end must be perfect. Thousands of lamps are being made every month by the Western Electric Company with a filament having a cross section of one-quarter that of the standard. It is almost impossible to see these filaments with the naked eye, unless in a strong light and with a white background. By great ingenuity and expert workmanship it has been found possible to make a curled filament, that is, having a loop in it of over 1,00 ohms in resistance when hot, and still be able to place it in the standard-size miniature lamp having a globe of one-quarter of an inch in diameter. This lamp gives a satisfactory signal or illumination, with thirty-five milamperes of current and gives a satisfactory life on forty-eight volts, although it is usually operated anywhere from thirty-five volts to the maximum.

In order to make the filament within the proper range and to secure a satisfactory service for a long life it is necessary to burn each filament in a vapor of gasoline or other hydrocarbon. When it becomes quite hot in the presence of a hydrocarbon vapor the gasoline is decomposed and a very thin coating of fine carbon or graphite is deposited on the red-hot filament.

The lamp globe is a high-quality glass tube rounded on the front end, one-quarter of an inch in diameter, and about one inch in length. The stem, on which has been mounted the filament, is inserted in the open end and sealed so that it is airtight along the outside portion of the stem. The air is later exhausted through the small hole in the center of the stem and closed up tight so as to prevent the air getting back into the lamp.

The stem is prepared from one-eighth inch tubing. The mounting wires where they pass through the glass globe are made of pure platinum. The filament is fastened to the mount or stem wires by means of a carbon cement, which is of such a character that it will not retain gases which may be within its surface or given off from any binder which may hold the carbon together.

All lamps are given a thorough inspection for possible defects. Tests must be made in a few hours which in a way represent the actual operating condition of the lamp in service. As a defect in any part of the lamp may cause failure in the final product, very great precautions have been taken to perfect every portion so that the lamps will have the utmost reliability. How well this has been done may be judged from the fact that the great majority of the lamps will burn many thousands of hours before burning out.

In the accompanying full-size illustration, 1 is the lamp cap; 2, the lamp stem unmounted; 3, the lamp stem with filament complete; 4, the lamp after pumping; 5, the lamp ready for the terminal; and 6, the finished product.

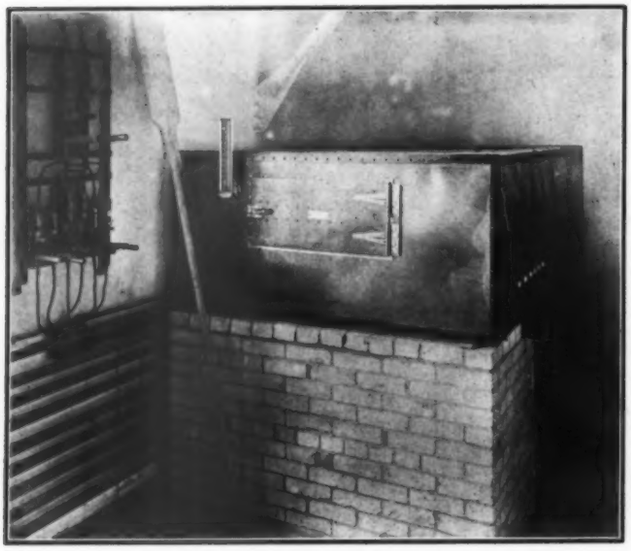


FIG. 1—DESPATCH OVEN IN BAKERY.

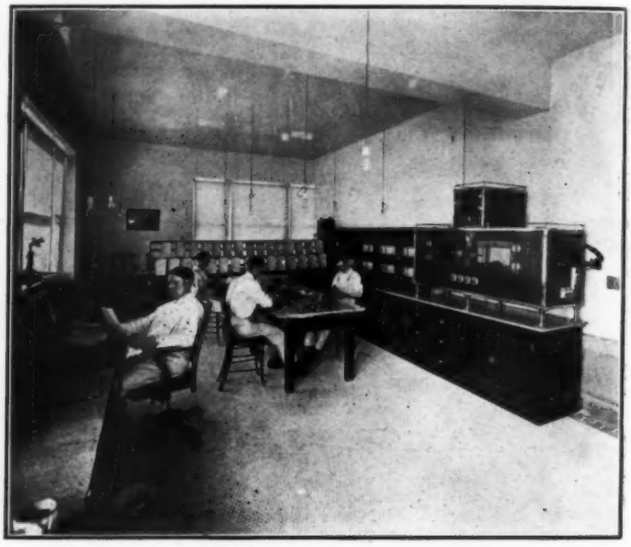


FIG. 2—ELECTRIC OVEN IN LABORATORY.

Installation of Electric Ovens.

The two accompanying illustrations are very good examples of typical installations of electric ovens and it is instantly apparent that the two desirable features of cleanliness and pleasing appearance have been admirably obtained.

In Fig. 1 is shown a Despatch bakers' oven, recenty installed in the modern bakery of the Russell Miller Milling Company at Minneapolis, Minn. This is an eighty-loaf oven and weighs 4,000 pounds, the interior construction being of brick tile. This oven requires 17,000 watts one hour each day when in continuous use; that is, this amount of current is used for one hour to bring the oven to the baking point. The current is then turned off and, owing to the heat-storage facilities of the oven, enough heat is stored to accomplish several bakings with the initial heating. This same principle applies to all ovens of this make. The door of the oven shown in Fig. 1 is constructed entirely of an asbestos composition. Twenty Despatch open-wire electric heating units are used in this installation.

Fig. 2 shows a Despatch oven, electric dryer and proving cabinet in the wheat and flour testing laboratories of the same firm. This laboratory is considered to be one of the finest in the country for wheat and flour testing.

These are two of the many notable installations which the Despatch Manufacturing Company, Minneapolis, Minn., is making. This company manu-

factures electric ovens for every purpose and their approved construction, and their economy and cleanliness have resulted in their widespread application.

Magnetic Circuits of Induction Meters.

An improved form of meter, having independent elements in the magnetic structure, has been developed by the Sangamo Electric Company, Springfield, Ill., and known as the type H. This meter is fundamentally the same as the Gutmann meter made by the Sangamo Company a number of years ago, except that the Gutmann had series coils without iron cores, so that a very small torque was obtained for the same expenditure of energy as the type H.

In the type H Sangamo meter the potential or shunt magnet is a complete unit, both mechanically and electrically, being fastened in the meter independent of the structure of the series laminated magnet. The series laminated magnet consists of a simple U-shaped yoke, made up as a unit, and riveted together, having on the other side of the disk from its poles a return plate, in which the armature rotates.

FIG. 1—FRONT VIEW OF MAGNETIC CIRCUIT.

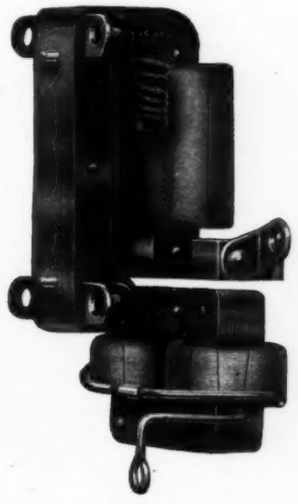


FIG. 2—SIDE VIEW OF CIRCUIT.

This construction, shown in Figs. 1 and 2, is said to be a decided advance in design, as it permits of easy removal and repair of either shunt or series coils without disturbing the other element. It is also desirable in that the design of the curved magnetic return plate of the series magnet, with its laminations placed edgewise to the field, gives a mixmum radius of action for both the series and shunt fields. As will be noted the gap of the shunt field stands in between the poles of the series magnet, so that the several poles are in the closest possible relation.

Another advantage of this construction is in permitting the use of a laminated core for the shunt element, having but a single air gap. This insures perfect uniformity and alinement in the gap, and reduces the magnetic leakage, which must occur at each joint or gap in a magnetic structure, even when interlaced. Aside from the importance of the several elements of the magnetic circuit, the curved return plate is most useful in preventing severe short-circuits from affecting the permanent magnets, as the return plate offers an effective closed path for the surplus magnetic flux from the series magnet, during a condition of extreme overload or short-circuit. The shape of this return plate or yoke above the disk is such that the spreading lines of force under short-circuit conditions naturally tend to travel along the curved lines defined by the laminations of the return plate, so that with its front well forward of the plane of the series yoke, no stray lines are left to act upon and weaken the permanent magnets.

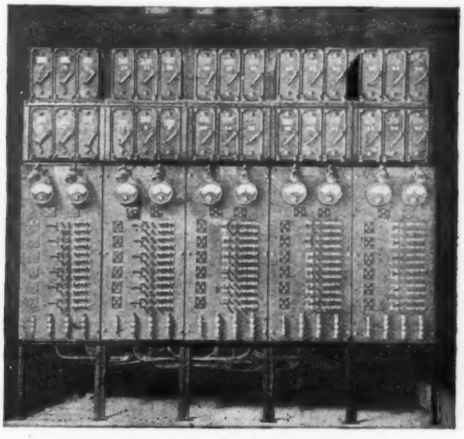
Telephone Train Dispatching.

The Chicago, Milwaukee & Puget Sound Railroad will soon be using the telephone to dispatch its trains between Mobridge, S. D., and Deer Lodge, Mont., a distance of 755 miles. An order has just been placed with the Western Electric Company for seventy-five sets of its new selector and telephone equipments.

Copper wire running 210 pounds to the mile will be used for these circuits.

Direct-Current Battery-Charging Panels.

Where conditions, as in the case of a public garage, require the charging of the batteries of several vehicles simultaneously from the same source of supply, a suitable switching apparatus is necessary. The General Electric Company's garage type of direct-current battery-charging panels are designed to satisfy all the requirements of ordinary service. They are built on the unit-panel system, the standard panels being equipped to take care of two, four or six charging circuits. When two or more panels are assembled in one switchboard, all the panel fuses are connected to the common source of supply. The circuit switches are fused against trouble on the individual feeders and are made double-throw, thus permitting the use of one ammeter to read the current on any one of the circuits although not more than one circuit can be read at a time. Potential receptacles and the necessary plug are provided to enable the reading of the voltage of the source of supply and also the voltage actually applied to the battery outside the charging rheostats. The latter are mounted compactly above the panels, the upper ties being conveniently operated by means of a special operating rod. This feature is of value where the floor space is limited, and possesses the additional advantage of placing the complete control of any circuit immediately under the hand of the operative.



DIRECT-CURRENT CHARGING PANEL.

In addition to the public garage type of panels, a standardized line of one and two-circuit panels are available for private garages.

New Oil-Break Switch for Manhole Service.

It is oftentimes desirable to install an oil-break switch in a manhole or other location where obviously the ordinary type of oil-break switch is not adapted to this service, as there is danger of flooding. To meet this need, the General Electric Company has developed a water-tight oil-break switch substantial in construction and suited to operation on circuits up to 7,500 volts, in which the normal current rating is 200 amperes or less.

These switches are made in non-automatic form, single, double and triple pole, single throw. The frame cover and oil vessel are of cast iron and all joints are made water-tight by means of gaskets. The frame is provided with a large vent hole to which a pipe may be connected and extended above the water line to prevent undue strain on the gaskets, due to gases generated when the switches are opened under load. The operating handle is outside the frame and can be operated by hand or by a hook. The shaft to which the handle is attached passes through the frame in a water-tight stuffiing box. The leads are carried to and from the switch through the bottom of the frame, water-tight bushings being provided for this purpose on the frame.

The double and triple-pole switches are so arranged that each lead may pass through a separate outlet, or one outlet may be used in each end of the frame for double and triple-conductor cable.

The stationary contacts consist of flared fingers of drop-forged copper supported from the contact blocks of the current-carrying copper studs by heavy flat-steel springs. The studs are supported and insulated from the frame by porcelain insulators. The movable contacts are wedge-shaped copper blades actuated by specially treated wooden rods connected to the cross head, which in turn is operated by the handle and actuating mechanism.

OIL-BREAK SWITCH.

New Folding Reel.

The Oshkosh Manufacturing Company, Oshkosh, Wis., is placing on the market a new folding take-up reel, shown in the accompanying illustrations, which embodies several commendable features. In place of the old-style clumsy wooden reel which not only takes up a great deal of room on the trouble wagon and elsewhere but is very unsatisfactory as a whole, the new reel has an iron wheel. When the coil is made it is merely necessary to loosen a pin and the wheel collapses, allowing the coil to drop off. Best of all is the folding feature of the stand. By merely unhooking a couple of cross bars the stand can be folded flat.

REEL FOLDED AND IN POSITION.

The Oshkosh Manufacturing Company is the consolidation of the Oshkosh Logging Tool Company, the A. Stanford Logging Tool Company, and the Oshkosh Tool Manufacturing Company, all of Oshkosh, Wis. The new company, by reason of this consolidation, will have much greater manufacturing, engineering and shipping facilities and the high standards set by each individual firm heretofore will now, if possible, be raised to an even greater degree.

New Alternating-Current Rectifier.

The Wagner Electric Manufacturing Company, St. Louis, Mo., is placing on the market a new alternating-current rectifier suitable for charging small storage batteries from alternating-current lighting or power circuits. As may be seen in the illustration, the device is small, compact, easily portable and comparatively light in weight.

The rectifier consists of three parts in one case: (1) a small two-coil transformer, the function of which is to reduce the voltage of the alternating-current supply to a low voltage suitable for charging the battery; (2) the rectifier proper; consisting of a vibrating armature in connection with an electro-magnet; and (3) a resistance which limits the flow of charging current.

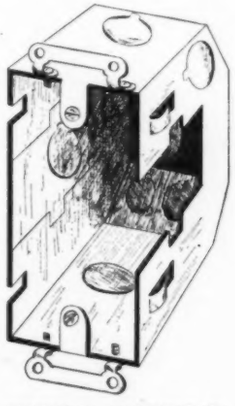
The principle of operation of the rectifier is simple. Its function is to permit current flowing in one direction only to pass to the battery. This is quite simply accomplished by means of the vibrating armature above mentioned when operating in connection with the small transformer.

WAGNER RECTIFIER.

The storage battery connections are from two substantial binding posts. It is quite immaterial which binding post is connected to the positive or to the negative terminal of the battery, charging satisfactorily proceeding, regardless of the way the positive and negative terminals are connected to the rectifier. When so connected the operation begins automatically, requiring no attention. The rectifier weighs twelve pounds.

The New Economy Switchbox.

The accompanying illustration shows a new switchbox which is being placed on the market by the Economy Switchbox Manufacturing Company, of Cleveland, Ohio. The feature of this box is the method of knocking out either side so that the boxes may be used in gangs of any number. The box is made from one piece of galvanized metal, No. 14 gauge, all sides being electrically welded. The box is two and three-sixteenths inches deep, three and twenty-nine thirty-seconds inches long and one and seven-eighths inches wide, inside measurement. The box is fitted with knockouts for either rigid pipe and conduit, or flexible-conduit work. There are two knockouts in the bottom, one in each end, and one in each portion of the box forming a permanent side, and there is also a knockout in



ECONOMY SWITCHBOX.

the removable portion of the side of the box. The box may be used as a single unit by leaving intact both sides, but a portion of one or both sides may be removed, as shown in the illustration, when it is to be built into gangs.

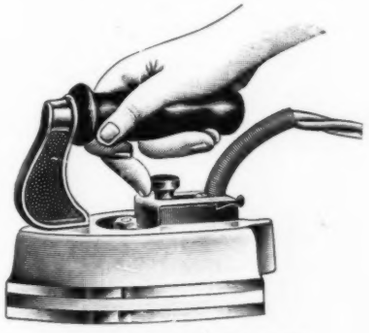
The side pieces are punched for a complete cut, except at two places in the center of the punched portion which remained integral with both the knockout and the permanent portion of the box. In order to remove the side it is necessary for the workmen to hammer down one end and then bend the side back and forth with the pliers until the holding lugs are broken. The entrance knockouts are made in the form of a cover, rather than a wedge filling the holes. In punching out the plugs a small ear is left adhering, the act of driving the plug expanding the metal and rendering it slightly larger than the hole from which it has been driven. The adhering ear holds the plug in position. The plug is bent back to cover the hole, the offset being on the inside of the box. When it becomes necessary to effect an extrance, the plug is knocked clear and the ear is broken off by bending the cover back and forth a few times.

This box is designated as the type "K C," it has been approved by the underwriters, and is furnished either galvanized or black japanned. The lugs for attachment to push-button switches are furnished with brass screws.

The box is equipped with spur catches on one side, these fitting into reciprocating slots on the opposite sides of the box when the boxes are used in gangs.

The Pelouze Electric Iron.

Since the Pelouze electric iron was first offered to the trade several slight



PELOUZE ELECTRIC IRON.

improvements in design have been made although the general principle of design and construction, which has stood the test of time, remains unchanged. In the accompanying illustration is shown the Pelouze Electric Heater Company's (Chicago) most modern type, which, the company claims, embodies several advantageous features unique in electric-iron construction.

The current and temperature in this iron is controlled at the iron by a simple movement of the hand while ironing. This feature not only is very convenient but also effects a saving in current. The heating coil is wound in a flat plane, easily removable, which provides for an even distribution of heat on the bottom surface. The body is filled with magnesia asbestos which prevents heat from radiating upwards and while this feature provides comfort for the operator, it also prevents cord troubles due to the wire heating.

Another advantageous feature is the "rest" which forms a part of the iron casting. When the iron is not in use it is tipped back on the rear lugs and end of the handle.

Prominent Electrical Men Establish Consulting Engineering Company.

An announcement of more than usual interest in electrical engineering circles has recently been made in connection with the establishment of the consulting engineering firm of Woodmansee, Davidson & Sessions, with headquarters in the First National Bank building, at Chicago, Ill. The firm is composed of Fay Woodmansee, C. J. Davidson and E. O. Sessions. This company is prepared to handle consulting, civil, electrical and mechanical engineering propositions of any character or magnitude, and the combination is a particularly happy one, as each member enjoys a splendid reputation as an engineer and each is fitted by education and experience to bring to any problem engineering skill and ability of the highest degree.

Fay Woodmansee began his first practical work in engineering with the Government on the Deep Waterway Survey of the Hudson River from the Troy State Dam to Germantown in 1898. On January 1, 1899, he entered the employ of the General Electric Company, at Schenectady, as a draftsman in the Switchboard Department. In July, 1900, he became connected with the Switchboard Engineering Department. He remained with the General Electric Company until February 1, 1903, when he became electrical engineer for Sargent & Lundy, consulting engineers. This position he held until his retirement from this company on April 30 last. While with the General Electric Company, Mr. Woodmansee was in charge of all railway switchboards, the large Power and Mining and Lighting Department switchboards and undertook the design and development of a large number of big power propositions. During his connection with Sargent & Lundy he was notably connected with the rehabilitation of the International Street Railway at Buffalo, N. Y., the building of the electric light plant at Wichita, Kas., the remodeling and construction of the power plant of the Twin City Rapid Transit Company, the building of the power plant of the Decatur & Springfield

Electric Railway, the steam plant at Oakand, of the Great Western Power Company, the power house for the Norfolk & Portsmouth Traction Company, the new power plant at Atlantic City, N. J., of the Atlantic City Electric Company, the plant of the Winona International Railway Company, at Winona Lake, the substations for this company, and many other power developments of greater and less importance.

Mr. Woodmansee has also been retained as expert and appraiser in connection with the placing of investments in a number of power propositions. He is a member of the American Institute of Electrical Engineers, the Electro-chemical Society, and several other engineering and scientific organizations.

FAY WOODMANSEE.

C. J. Davidson has had a unique and valuable experience in the operation and management of power plants of various descriptions. His early experience included shop work, operating experience in various branches of steam and electrical power plants, and in charge of minor installations. In 1888 he was appointed chief engineer of what was then known as the Haakenson Packing Company (now the Cudahy Packing Company), in Sioux City, Iowa. This position he held for five years and then accepted the position of chief engineer of the Sioux City Traction Company, which position he resigned in the early part of 1899 to become chief engineer of the power plants of the Milwaukee Electric Railway & Light Company. This position Mr. Davidson held until his retirement to form the present organization. Mr. Davidson's work with the Milwaukee company has included not only the operation but the design and construction of various plants which have been built by this company, and the design and to a large extent the supervision of the Ashley Street plant of the Union Electric Light & Power Company, of St. Louis, Mo., and the construction of the power plant for the Wisconsin Traction, Light, Heat & Power Company in Appleton, Wis. During the last five years Mr. Davidson has also been general superintendent of the Milwaukee Central Heating Company.

C. J. DAVIDSON.

Mr. Davidson is a member of the American Society of Mechanical Engineers, an associate member of the American Society of Naval Engineers, a member of the Verein Deutsche Ingenieure, member of the Engineers' Society of Wisconsin, and a member and past president of the Engineers' Society of Milwaukee.

E. O. Sessions entered the drafting room of the Thomson-Houston Electric Company at Lynn, Mass., in 1889, and became assistant superintendent of the Edison General Electric Company, in New York, in 1891. He resigned in 1893 to organize the Northern Electrical Manufacturing Company, with headquarters at Boston, Mass., and from 1894 to 1896 was general superintendent for the Hon. Frank Jones, of Boston, Mass., during which time he installed thirty power plants and three railways for Mr. Jones. From 1896 to 1901 he was engineer of construction for the General Electric Company at Schenectady, N. Y., and from 1901 to 1908 was engineer for the Stanley-G. I. Company. In 1908 he joined the General Electric Company as special engineer, which position he held until his retirement from that company on May 1, last. Mr. Session's experiences have included the design and construction of the largest modern power plants, generating and distributing electrical energy at both high and low tensions. He was associated with and in special charge of the design, construction and installation of the plants of the North Shore Electric Company, in Chicago and vicinity, the Waterside Station of the New York Edison Company, the third-rail system of the Albany & Hudson River Railroad, the power plant of the Michigan & Lake Superior Power Company at Sault Ste. Marie, the plant of the Citizens' Electric Company at Houston, Texas, the installation of the Chicago & Western Indiana Railway, the Union Stock Yards & Transit Railway, the Cleveland & South Western Railway, the plant of the Hudson River Power Company at Mechanicville, N. Y., the plant of the Union Electric Company at Dubuque, Iowa, and many other similar installations.

E. O. SESSIONS.

Mr. Sessions is a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society, Electric Club of Chicago, and other organizations of a similar character.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

At the hearing before the Public Service Commission, Second District, on the complaint of residents of Granville as to alleged excessive rates of the Granville Electric & Gas Company for electricity and gas, the only appearance for complainant was Milford D. Whedon. Attorney Brodie G. Higley, who is also president of the company, by a series of questions endeavored to have Mr. Whedon admit that his complaint was filed because of personal spite. He sought to impress this upon the Commission, by referring to Mr. Whedon as the only complainant who was interested enough in the proceeding to attend this hearing. Commissioner Decker told Mr. Higley that this phase of the situation would not be considered by the Commission, but that the case would be disposed of entirely on its merits. An accountant of the Commission will inspect the company's books to ascertain the use of the proceeds of certain securities which the company proposes to take up at this time by an issue of $12,500 on bonds.

The Public Service Commission has made an order directed against the Delaware & Otsego Toll Line Telephone Company and the Walton Home Telephone Company to show cause before the Commission at Albany on May 29, why an action should not be commenced to recover penalty for the failure of the company to file schedules of rates as required by the order of the Commission. All other companies in the State except these two have complied with the order of the Commission in relation to this matter.

In a recent letter written to the Public Service Commission, First District, by the Interborough Rapid Transit Company, extensive proposals were formulated for subway and elevated lines. The Interborough, through President T. P. Shonts, makes a series of concessions from its position expressed in its letter of December 5, 1910. It proposes additional routes, especially in Brooklyn, to Astoria, Woodside, Buffalo Avenue, and a connection between Lafayette Avenue, Brooklyn, and Fourteenth Street and Broadway, Manhattan, by a new tunnel, so that there would be in its enlarged system six crossings of the East River.

These proposed subways are to be constructed jointly by Interborough and city money. The company leaves to the city to extend, as it may conveniently under its own construction, these routes to Flushing, Jamaica, New Lots Avenue, to Coney Island by Nostrand Avenue, and from Forty-third Street, Fourth Avenue, Brooklyn, to Fort Hamilton, and by a branch from this last line to Staten Island by tunnel under the Narrows.

The new offer, the company says, including the elevated improvements and the Belmont tunnel, represents a construction cost to the Interborough Company of $88,478,500 and an equipment cost of $45,346,000, or a total contribution by the company of private capital in the amount of $133,824,500, or almost two dollars for each dollar invested by the city.

LIGHTING AND POWER.

(Special Correspondence.)

NEW LONDON, IOWA.—The council will put in an electric light plant. C.

EAU CLAIRE, WIS.—The installation of a White Way is being agitated. C.

ANSELMO, NEB.—Bonds for the erection of an electric light plant have been voted. C.

HIBBING, MINN.—The municipal lighting plant of this city was completed recently.

TROUP, TEX.—R. C. Schumate, of Zephyr, Tex., has purchased the local electric light plant.

ROLAND, IOWA.—Bonds for $8,000 have been voted to construct an electric light plant.

SENTINEL, OKLA.—This city has voted $12,000 in bonds to establish an electric light plant. P.

SILVER CREEK, N. J.—The sale of the local electric light plant to the city is contemplated.

FARGO, N. D.—The White Way system of lighting will be extended along lower Front street. C.

LANSING, IOWA.—The Upper Iowa Power Company has been granted an electric light franchise. P.

McALLEN, TEX.—A. L. Stang, of El Campo, Tex., has been granted an electric light franchise here. P.

PROCTOR, MINN.—The Proctor Water & Light Company has been granted an electric light franchise. P.

WAUBAY, S. D.—Work has been commenced on the construction of the electric light plant building. C.

PORT LAVACA, TEX.—W. E. Shell & Company contemplate the construction of an electric light plant. P.

ROLAND, IOWA.—Bonds to the amount of $10,000 have been voted for a pumping and electric light plant. P.

BARTLESVILLE, OKLA.—The Bartlesville Light & Water Company will expend $106,000 on improvements. P.

WETUMPKA, OKLA.—This ctiy has voted bonds for $10,000 for electric light and water works extensions. P

WAUBECK, IOWA.—K. S. Tasker is considering the construction of a power plant on the Wapsipinicon River. C.

LITCHFIELD, MINN.—The Council has ordered the installation of twenty-six ornamental lights at a cost of $2,600. C.

PATTERSON, LA.—The Patterson Light & Power Company has been incorporated with a capital stock of $8,000. P.

WELEETKA, OKLA.—This city has voted bonds to the amount of $45,000, for electric light plant and waterworks. P.

ROCHESTER, MINN.—Plans for a street lighting system are being prepared by Earle D. Jackson, engineer, St. Paul. C.

MONTGOMERY, ALA.—The electric light plant was recently put in operation and is now supplying the city with light.

EXCELSIOR, MO.—The Excelsior Water, Gas & Electric Company has been incorporated with a capital stock of $500,000. P.

JEWELL, IOWA.—A site has been secured for the erection of a brick building, for the installation of the electric light plant. C.

FORT DODGE, IOWA.—The Northern Iowa Power Company is planning the construction of a large dam north of the city. C.

BELLE PLAINE, IOWA.—Subscription lists are being circulated for the purchase of electroliers for the business district. C.

FORT PIERRE, S. D.—Steps are being taken for the installation of an electric light plant with twenty-four hour service. C.

BARABOO, WIS.—The Council will secure an electrical expert to draw plans for the installation of a municipal lighting plant. C.

GREENSPRING, O.—A franchise has been granted to D. M. Scott to build an electric light and power plant in this village.

BOONE, IOWA.—The Central Iowa Light & Power Company, capital $5,000, has been incorporated to supply power and light. C.

KNOX CITY, TEXAS.—R. W. Warren will install a combination electric light plant, an ice plant and a steam laundry here. D.

MILTON, DEL.—This town is to be supplied with electricity from the plant of the Milton Light & Power Company at Ingram's Mill.

MOROCCO, IND.—The Commercial Club is promoting a company to build and equip a combined water and light plant in this town. S.

FORT DODGE, IOWA.—The Northern Iowa Power Company has commenced the construction of a dam to develop 200,000 horsepower. C.

LYLE, WASH.—The Pacific Power & Light Company purchased a power plant twenty-five miles east of town and will enlarge it. C.

PASCO, WASH.—This city proposes to issue $50,000 in bonds to purchase and improve the plant of the Pacific Power & Light Company.

HAMPTON, IOWA.—The local electric light plant was burned. It will be rebuilt at once. The loss was $40,000. There was no insurance. C.

FLORESVILLE, TEX.—A. B. Crawford, of San Antonio, has been investigating the proposition of installing an electric light plant here.

SALEM, ORE.—The City Council has voted to purchase the plant of the Salem Light, Water & Power Company at a price of about $370,000.

CASTLE ROCK, WASH.—The Silver Lake Railway & Lumber Company has been granted a franchise for an electric lighting system in this city. A.

WEBSTER CITY, IOWA.—It is proposed to take a vote on issuing bonds for $25,000 for the installation of an electric light and power plant. C.

FORREST CITY, ARK.—A new boiler has been installed by the city water and light plant and in the future a twenty-four-hour service will be given.

STATE CENTER, IOWA.—The municipal electric light plant was recently burned. The loss was $20,000, with $2,300 insurance. It will be rebuilt. C.

TEMPLE, TEX.—A new lighting system has been installed in

the yards of the Santa Fe Railroad Company here. Ornamental iron posts are being used.

FLANDREAU, S. D.—The installation of an electric light plant at an estimated cost of $20,000 is being agitated. Mr. Shaver of St. Paul, is interested. C.

KEOKUK, IOWA.—A vote was taken on May 25 on granting a franchise to the Stone & Webster Corporation to operate a street railway and power company. C.

SUSANVILLE, CAL.—James Branham has applied for an electric lighting franchise in this city. The franchise will be sold to the highest bidder on June 1. A.

LAFAYETTE, KY.—A light and ice company has been formed here and machinery for a modern lighting plant ordered. It will be installed in a very short time.

SONORA, CAL.—The electric power line of the Merced Gold Mining Company will be extended from its present terminus at Penon Blanco to Coulterville, Cal. A.

ALICE, TEX.—A franchise has been secured for an electric light plant which will be operated in connection with an ice plant. Both will be in operation in a short time.

WAUBEEK, IOWA.—K. S. and W. S. Tasker who are seeking an electric light franchise for Mt. Vernon, are preparing to erect a power dam with an eighteen-foot head. C.

MANCHESTER, TENN.—This town recently voted the issuance of bonds to the amount of $25,000 for the purpose of installing a water and electric light plant.

MADISON, WIS.—The Peninsular Power Company has been incorporated with a capital of $750,000. The incorporators are H. J. Hunt, A. W. Tressler and D. H. Otis.

GRANGEVILLE, CAL.—The management of the Grangeville Light & Power Company is now figuring on the extension of its power lines into the Ten Mile mining district. A.

CANYON CITY, TEX.—The Canyon City Power Company has been organized with a capital of $25,000 and will conduct a light and power business in connection with an ice plant.

WEISER, IDAHO.—The Sunnyside Orchard Company has installed two ten-inch pumps driven by forty-horsepower motors. The pumps will supply water to 500 acres of apple trees.

KENDALLVILLE, IND.—Bids have been advertised for a new 400-kilowatt generator to be placed in the lighting plant here. Improvements to be made will probably amount to $25,000.

LOS ANGELES, CAL.—The Board of Supervisors of this county is receiving sealed bids for the furnishing of the necessary equipment for the lighting of the Hawthorne Lighting District. A.

TOLEDO, O.—Mayor Brand Whitlock has approved the new lighting ordinance passed by Council, providing for a seven-cent net rate per kilowatt-hour with a fifty-cent minimum charge. H.

REDWOOD CITY, CAL.—A franchise for the right to operate an electric light and power company in the country north of Halfmoon Bay has been sold to J. J. Gomes and Ben Cunha.

QUINCY, CAL.—Leroy G. Brown has filed a notice of the appropriation of 50,000 miners' inches of water to be taken from the North Fork of the Feather River for electric power purposes. A.

HATFIELD, WIS.—The La Crosse Water Power Company, of La Crosse, is planning the construction of another power plant, eight miles from the city, estimated to cost, complete, $500,000. C.

EL MONTE, CAL.—The El Monte Light & Water Company has been incorporated at this place with a capital stock of $25,000 by A. F. Snell, I. T. Baker, G. H. Coffin, S. Shirpser and M. Kauffman. A.

FORT WORTH, TEX.—J. R. Nutt, of Cleveland, O., and associates who have the contract for the installation of the $1,500,000 electric power plant for this city, have started work on the enterprise. D.

NEWPORT, CAL.—The City Council has called an election to take action on the proposition of issuing bonds to the amount of $55,000 for the purpose of constructing a municipal electric lighting plant. A.

BROWNWOOD, TEX.—Dr. M. M. Scott, who recently purchased the townsite of Owens, near here, will make extensive improvements to the property, including the installation of public utility plants. D.

ELWOOD, IND.—The Bacon-Olds Company is preparing to spend $100,000 on the improvement on the Citizens Heat & Light plant. Considerable new machinery and apparatus will be installed. S.

PASADENA, CAL.—General Manager Koiner of the municipal lighting plant estimates that the cost of the needed additional unit to the city's electric lighting plant will be between $30,000 and $35,000. A.

COLORADO SPRINGS, COLO.—At least $50,000 is to be spent in improving the system of the Colorado Springs Light, Heat & Power Company, according to a recent statement of one of the company officials.

GADSDEN, ALA.—E. R. Le Fevre, L. L. Herzberg, E. T. Hollingsworth, J. D. Dunlap, T. S. Kyle and Charles P. Smith, of this place, have applied for franchise to distribute electricity. They plan the construction of a waterpower electrical plant developing 20,000 horsepower.

MONTICELLO, IOWA.—Fred J. Cross, of this city, has been granted franchises to install light and power systems in Cedar Point, Walker, Coggon, Central City, all to be operated from a central power plant. C.

COLUMBUS, O.—An ordinance has been passed providing for the issuance of $20,000 in bonds for the new cluster light system. A committee of citizens has been appointed to select an appropriate design for the lights.

ROSENBERG, TEX.—The City Council has accepted the proposition of a representative of a Houston engineering company to place an electric light plant here. The building is now in the course of construction.

MADISON, WIS.—The Peninsula Power Company, capital $750,000, has been incorporated to build an electric light and power plant on the northern peninsula of Michigan. D. H. Otis, C. A. W. Tresler and others, incorporators. C.

ROCHESTER, N. Y.—Tests of arc lamps are being carried on here, with the intention of changing the street lighting system before July, when the Imperial Council of Shriners meets here. Flaming-arc lamps will probably be used.

FORT DODGE, IOWA.—The Northern Iowa Power Company, composed of Humboldt and Fort Dodge capitalists, is projecting a $200,000 hydroelectric scheme. It is planned to build a dam just north of this city on the Des Moines River.

GOLDENDALE, WASH.—D. B. Hopper of Cedar Valley, eighteen miles northeast of Goldendale, has received an offer of $40,000 for the water rights on his ranch. It is believed it is wanted for power for an electric railway from Goldendale to Maryhill.

MANISTEE, MICH.—The properties of the Manistee Light & Traction Company have been sold under foreclosure by John S. Lawrence, of Boston, the price being $145,000. The bid was made on behalf of Mr. Edwards by Charles Wilson, of Grand Rapids.

YORK, PA.—The contract for the ornamental lighting of Central Square has been awarded to the Edison Electric Light Company. There will be twelve standards carrying five lights each. These will be furnished by the Smyser-Royer Company.

REDDING, CAL.—The Northern California Power Company has begun work on its proposed 6,000-foot tunnel near Millville, Cal., this being the first step in the construction of a 15,400-acre reservoir in which water will be conserved for electric power purposes. A.

OXFORD, N. C.—The Oxford Electric Company and the Oxford Water Company, each with a capital of $15,000, have been formally chartered, those interested being Richard C. M. Calvert, College Park, Md.; Chas. F. Nesbit, Washington, D. C., and A. H. Powell, Oxford, N. C.

AVON, N. Y.—The Livingston-Niagara Power Company, whose headquarters are in this place, has the contract to furnish 200 electrical horsepower to the State Farm at Industry. The new transformer station at Golah, which the company is now building, is about completed.

HARTFORD CITY, IND.—The Muncie Electric Light Company, the Hartford City Lighting Company, the Dunkirk Lighting Company and the Eaton Electric Company have now been merged into one company. The corporation is to be known as the Muncie Electric Light Company.

DELANO, MINN.—The Oscar Claussen Engineering Company, St. Paul, will draw up a preliminary report on the remodeling or new construction of an electric light plant to give a twenty-four-hour service. It is proposed to take a vote on issuing bonds for the improvement. C.

YORK, PA.—The Edison Electric Light Company of this place is considerably enlarging its present plant capacity by the addition of a 2,000-kilowatt Westinghouse-Parsons steam-turbine generating set. The new apparatus is expected to be installed by July and ready for operation early in the fall.

TUCUMCARI, N. M.—The Tucumcari electric light plant has been sold to I. G. LaFite, of Denver, Colo., the sale price being $22,000. Improvements to the amount of $10,000 will be made on the plant, a day service being added and several miles of additional wire being strung for suburban users.

DELANO, MINN.—The Oscar Claussen Company, of St. Paul, Minn., will draw up a preliminary report on the remodeling or new construction of an electric light plant to furnish twenty-four-hour service. The proposition of securing a bond issue to make the improvements will be submitted to popular vote.

MUNCIE, IND.—The Muncie Electric Lighting Company, capitalized at $1,000,000, has filed articles of incorporation. The purpose is to merge the electric lighting interests of Hartford City, Red Key, Dunkirk, Eaton, Muncie and other towns and cities, the current to be supplied from the power plant at Muncie. S.

HELENA, MONT.—Articles of incorporation of the Landers Power Company have been filed. The company is incorporated with a capital stock of $100,000 and the directors are Owen Byrnes, O. M. Lanstrum, F. B. Linderman, W. W. Patterson and F. M. Hall. The principal place of business will be at Gould.

REDDING, CAL.—The Siskiyou Light & Power Company, of Yreka, Cal., has secured from the Board of Supervisors of Shasta a fifty-year franchise for transmission lines covering the streets and highways of that county outside of the incorporated towns. The company will at once extend its line south from Dunsmuir to Castella. A.

BUTLER, PA.—The Pittsburg-Hickson Company, of East Butler, has closed a contract for a large addition to its power plant. The contracts include a battery of two 250-horsepower boilers, a 350-horsepower engine and an electric generator. The new generator, engine and boilers ordered will be installed and ready for use by July 1.

ST. MARY'S, O.—The Western Ohio Railway Company has made a proposition to the City Council to furnish current to the city for lights and for use as power. The matter is now being investigated by a committee of councilmen and citizens and it is thought the proposition will be accepted. The company has a power house located in this city. H.

STATE CENTER, IOWA.—The town council is making preparations to begin at once the rebuilding of the electric light plant, which was recently destroyed by fire. A contract for the building will be let at once, and bids for new machinery are being advertised for. It is expected that the new plant will be completed and ready for operation in the next few weeks.

MOBERLY, MO.—A twenty-year electric and gas franchise and a five-year street lighting contract has been voted to T. F. Fulkerson of Trenton, Mo. Mr. Fulkerson, who is associated with William Maul Measey of Philadelphia, recently purchased the property of the Moberly Gas & Electric Company and expects to spend about $150,000 in improvements.

NEW BRAUNFELS, TEX.—The City Council has adopted the preliminary plans of the W. K. Palmer Company, of Kansas City, Mo., for the construction of a large reinforced concrete dam across the Guadalupe River near here. The proposed dam will be for the purpose of affording the initial power for operating a large hydroelectric plant which the city will install. D.

DENVER, COLO.—A reorganization of the Colorado Railway, Light & Power Company will be effected by the new purchasers, represented by C. C. Chappel of Chicago. The company which furnishes light and power for Trinidad and adjoining coal camps recently went into the hands of receivers and the new owners are now planning to put the company on a sound basis.

OKLAHOMA CITY, OKLA.—The electric light lines of the Oklahoma Gas & Electric Company will be extended to Britton, to the new college for girls, one and one-half miles north of Britton, also east of the state fair grounds and to other sections of the city within the next three months. The cost of construction of the new lines to Britton alone will amount to about $20,000.

TERRE HAUTE, IND.—The City Council has approved the contract for lighting the streets and public buildings entered into by the Board of Public Works with the Terre Haute, Indianapolis & Eastern Traction Company. The contract covers a period of five years and the rate is fixed at $67 a light per year. The provisions of the contract were modified so as to be acceptable to the company. S.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has closed a $100,000 contract with the Spring Valley Water Company of this city to supply the latter company with electric energy to be used in the construction of a 230-foot dam behind which will be impounded 30,000,000 gallons of water. A transmission line ten miles long will be constructed to convey the current to the dam site. A.

BRAZIL, IND.—The City Council has approved the specifications prepared by Frank Kattman, city engineer, for lighting of the streets and public buildings of Brazil for a period of ten years. Bids will soon be called for and if the bids submitted are too high a municipal plant will be constructed and planned. The new contract, if one is made, will commence April 1, 1912, when the present contract expires. S.

SHEBOYGAN, WIS.—The $50,000 improvements at the power house of the Sheboygan Railway & Electric Company are now completed and the plant is in active service. The new 1,500-horsepower Curtis turbine was put into service on April 1. The company has also just spent an additional $15,000 for added boiler capacity and equipped three of its five boilers with smoke consumers.

JONESBORO, ARK.—The Spring River Power Company, recently organized here with a capital stock of $100,000, will install hydroelectric plants on Spring River, in this section, and construct power transmission lines to a number of towns. The main offices of the company are at Jonesboro. The officers are: F. R. Land, president; J. D. Brown, secretary, and W. H. Vaughan, treasurer. D.

AUSTIN, TEX.—W. P. Carmichael of the Carmichael Construction Company, of St. Louis, Mo., will submit a proposition to the City Commission for the reconstruction of the dam across the Colorado River here and the installation of a hydroelectric plant. Grant Hornaday, president of the Midland Construction Company, of Fort Scott, Kan., is also negotiating with the City Commission with the same object in view. D.

POTTSTOWN, PA.—A plant will be built by the Philadelphia Gas & Suburban Company which will furnish power everywhere withing a radius of twenty miles of here. The plant will contain three 1,000-kilowatt generators, five 400-horsepower boilers, and two 300-kilowatt rotary converters. Four electric pumps will be employed to pump water from the river. Improvements are also to be made in the lighting equipment at Pottstown.

HARRISBURG, PA.—Thirty charters for electric and gas companies were granted a short time ago. The companies will operate in parts of Delaware, Montgomery, Bucks, Luzerne, Chester and Erie counties. Most of the companies have been chartered by the same group of men, residing in Philadelphia and Luzerne county, each company having the nominal capital of $5,000 and being named for the district in which it will operate.

SPRINGFIELD, MO.—A group of Springfield men have in view the erection of a power house on the river near View, Stone County. The work, to cost in the neighborhood of $75,000, will start with the tunnelling of a bluff 200 feet in thickness that will allow water now flowing around a curve to flow straight. Several towns, including Berryville and Eureka Springs, Ark., will be supplied with power as soon as the plant is completed.

SAN FRANCISCO, CAL.—John Hays Hammond has now secured control of the La Grange Water & Power Company, owning water and power rights and a generating plant in Stanislaus County, Cal., and will, it is understood, operate this property in conjunction with two other power companies operating in the same neighborhod. It is reported that transmission lines will be extended to San Francisco and other cities and towns in central California. A.

ROME, GA.—According to statements of one of the officials of the Georgia Power Company, this place will be supplied with power not later than July 1, 1912. The company will have six plants with a total of 157,000 horsepower. These plants are located at Dunlap and Bull Sluice now in operation. That at Tallulah now under construction will develop 60,000 horsepower. Those to be constructed at Buford, 32,000, Newman, 24,000, and Etowah, 24,000.

DURHAM, N. C.—The line of steel towers of the Southern Power Company that will bring power at a high voltage to this city for industrial, lighting and general electrical purposes, is about completed, thus connecting Durham with the system 150 miles distant, including the several hydroelectric power plants along the Catawba and Broad Rivers in upper South Carolina. Material for the distributing and transformer stations are also on hand, and 10,000 horsepower will soon be available for use. L.

OGDEN, UTAH.—The Merchants Light & Power Company, of Ogden, which has recently been granted franchises for the lighting and power here, and which has also obtained the municipal arc-lighting contract, has awarded to the Falkenau Electrical Construction Company, of Chicago, the general contract for the complete installation and construction of this system. The work will be undertaken immediately and pushed to rapid completion. H. A. Strauss, consulting engineer, of Chicago, has prepared plans and specifications for this system and is now engaged in making the necessary purchases at his Chicago office.

ELECTRIC RAILWAYS.

(Special Correspondence.)

PALESTINE, TEX.—Tucker Royall and associates are promoting the construction of an electric street railway system here. D.

MANKATO, MINN.—The cost of the proposed electric line to St. Peter is estimated at $350,000. J. J. Cummings, Chicago, is interested. C.

DULUTH, MINN.—The Duluth Street Railway Company has commenced the rebuilding of the Woodland Park line with eighty-pound rails. C.

BOONE, IOWA.—The Chicago & Northwestern Railway Company let the contract to the Boone Electric Company for the supply of power. C.

TULSA, OKLA.—It has been announced by an official of the Oklahoma Union Traction Company that two miles more of city track will be built.

PORTERVILLE, CAL.—General-manager F. U. Nofziger of the Porterville Northeastern Railroad states that the road will be ready for operation by the first of July. A.

INDIANAPOLIS, IND.—The Monon Railroad Company has submitted plans to the Railroad Commission for electrical automatic block signals between Indianapolis and Chicago. S.

IRWIN, PA.—The Pittsburg & Westmoreland Street Railway Company has asked for franchises for additional lines. It has agreed to extend the trolley service to North Irwin.

RIVERSIDE, CAL.—The Pacific Electric Company has applied for a franchise between the city limits of this city and the Riverside-Orange county line, a distance of seventeen miles. A.

DES MOINES, IOWA.—The Des Moines City Railway Company is planning the expenditure this year of $75,000 installing improvements, for which the General Electric Company has the contract. C.

LOS ANGELES, CAL.—The contract for the construction of the Glendale-Burbank extension of the Pacific Electric Company has been let to Robert Sherer & Company. The line is to be completed within six months. A.

GREENVILLE, TEX.—A charter has been filed for the Mineral Heights Traction Company, which is to operate here. The capital stock is $17,500 and the incorporators are A. R. Nicholson, H. T. Weathers, A. W. Defee and others.

FRESNO, CAL.—F. S. Granger, of the Fresno Interurban Railway Company, reports that grading for the company's road is now well along and that the laying of ties and rails will begin on July 1. The road may be ready for operation by December 15. A.

HAGERSTOWN, MD.—The contract for the construction of an electric railway between Hagerstown and Clearspring, a distance of twelve miles, has been awarded by the Hagerstown & Clearspring Railway Company to the Burton Construction Company, of Richmond, Va. The road will cost about $270,000.

MT. AYR, IND.—Eugene Purtelle announces that Chicago capitalists have arranged to finance the construction of a traction line from Rennesselaer to Chicago by way of Mt. Ayr. Work on the new road is to be begun in a short time. S.

ESCANABA, MICH.—The Escanaba Traction Company let the contract for the construction of a concrete dam and pulp mill on the Escanaba River to Bragen & Rich, of Green Bay. A thirty-two-foot headway will be procured and 2,500 horsepower developed. C.

HASTINGS, MINN.—A. T. Stebbins, of Rochester; Albert Schaller, of Hastings; and Edw. Feldhauser, of St. Paul, have incorporated the Interurban Construction Company to construct an electric railway from the Twin Cities to Lake City, Minn. The capital is $100,000. C.

EAST ST. LOUIS, ILL.—The East St. Louis & St. Louis Traction Company has been incorporated with a capital stock of $2,500 to operate a street railway in East St. Louis and vicinity. The incorporators are L. C. Haynes, C. E. Hewitt, I. B. Sager, T. W. Gregory and M. W. Shaefer. Z.

AUGUSTA, GA.—The Augusta & Aiken Railway Corporation will soon begin the placing of its wires underground on the principal business streets. The American Telegraph & Telephone Company and the Postal Telegraph Company will also place their lines underground in the same district of the city. L.

FOND DU LAC, WIS.—A new interurban line, extending from Milwaukee to Fond du Lac and thence to Ripon and Berlin, will be constructed by the Milwaukee Western Electric Railway Company. Operations on the new line will begin early in June, according to a statement made by a representative of the company.

FT. WAYNE, IND.—R. W. Watson, vice-president and acting general manager of the Ft. Wayne & Northern Traction Company, announces that extensive improvements on the system have been decided on, the first of which will be the erection of new car barns in Ft. Wayne. The other improvements extend along the entire line. S.

CLINTON, IND.—The Terre Haute, Indianapolis & Eastern Traction Company is reported to have acted favorably on a petition by the citizens asking that the company build an extension of its line from Clinton to Fairview Park, an incorporated town three miles southeast. The territory has no railroad and the district is heavily populated. S.

FRANKFORT, KY.—A franchise has been granted for the construction and operation of an electric line between Elkhorn and Frankfort. It is proposed to construct a line of track from the fork of Elk Horn to join the Frankfort and Versailles traction line, three miles east of this city, and use that line until a track is constructed into this city.

ANOKA, MINN.—Building of the Minneapolis Northern Suburban Railway, the interurban railway that will connect Anoka, Onaway and Fridley with Minneapolis, was assured at a mass meeting when $30,000 in stock was subscribed. Actual work of construction on the line will start before June 1 and, according to present plans, the first car will be run August 1.

MEMPHIS, TENN.—Extension work on the lines of the Lakeview Traction Company will begin in a short time, the line going to Walls, Miss., at present and later to Clarksdale. The line will also be extended north from its present terminal in New South Memphis to terminal headquarters at Union Avenue and South Third Street by January 1 of next year.

SPRINGFIELD, ILL.—The Chicago, Waukegan & Woodstock Traction Company with capital stock of $50,000 has filed articles of incorporation to construct a railway from Waukegan through Lake and Henry Counties to Woodstock. The incorporators and first board of directors are Charles A. Spenny, Irving D. Stevens, W. P. MacCracken, Peter B. Olsen and H. S. Nedber.

AUGUSTA, GA.—Improvements that will represent an expenditure of $1,000,000 will be made on the local street railway system, it is said, one of these being the addition of facilities for supplying 3,000 additional horsepower. The system and the interurban line to Aiken, S. C., was purchased recently by Redmond & Company and J. G. White & Company, of New York, from the Harriman estate. L.

WABASH, IND.—The Ft. Wayne & Northern Indiana Traction Company is preparing to build a spur from its line in this city south in Lafountain Avenue to the Wabash Canning Company's packing plant to facilitate the transportation of material from the farms to the plant. The freight cars will be loaded at switches and towns all along the main line, thus relieving the farmers making long wagon hauls to the packing plant. S.

DURHAM, N. C.—With the coming of electrical energy and the building of a large substation here by the Southern Power Company it has been rumored that several short lines of hitherto steam railroad will be operated by electricity, and though no verification is had, a new road to Danville has secured a charter, and it is stipulated that steam or electricity may be used as a motive power for the same, this being the Durham and Danville railroad. L.

CHARLOTTE, N. C.—The Piedmont Rapid Transit Company, given a franchise some months ago to operate a line out Fourth Street, several miles to a suburb, will have cars in operation by September 1, maintaining a thirty-minute schedule, according to a deed just filed in the clerk of the court's office here. Paul Chatham is the leading promoter. Work has been started at the suburban terminus of the line, where grading is in progress. L.

VINCENNES, IND.—The subsidy election held in this city and township, May 19, in aid of the construction of three interurban roads, was carried by a safe majority. The tax will produce upwards of $100,000 and will be divided among the Vincennes, Washington & Eastern, the Vincennes Interstate, and the Vincennes North and South Traction Company. The voters in Palmyra and Steen Townships defeated the subsidy asked by the former company. S.

PARSONS, KAN.—The Southeastern Traction Company has been incorporated by D. H. Siggins for the purpose of extending his Montgomery county system from Cherryvale to Iola by way of Chanute and Humbolt. He has been granted a franchise by Iola, and Chanute has also granted him permission to construct and operate a city system there. Mr. Siggins is now planning to extend the Cherryvale-Coffeyville-Independence interurban system from Cherryvale to Parsons.

TOLEDO, O.—Edward W. Bemis, of New York, has been selected by the city of Toledo to make an appraisement of the valuation of the property of the Toledo Railways & Light Company for use in the negotiations between the city and street car company looking to a renewal of expired franchises on Toledo streets. It is expected that the work will be completed within two months. The sum of $8,000 was recently appropriated by Council to meet the expense of this appraisement. H.

CHARLOTTE, N. C.—The W. J. Oliver Company, which recently acquired control of the Salisbury-Spencer and Concord Street railways, and the franchise for the interurban line from Salisbury to Concord, has started the Concord line in operation with the LeFevre storage battery car. Work has been commenced on the interurban line that is to connect Salisbury wtih Concord. The line will touch half a dozen towns on its route. The line will probably be in operation by early fall.

LEWISTON, ME.—An order has been placed with the General Electric Company for the equipment of the Portland, Gray & Lewiston Railway. The road will run from here to Portland. The order includes three substation equipments each consisting of a 300-kilowatt rotary converter, transformers and switchboard. The power is received from the Lewiston & Auburn Electric Light Company at the first substation, at a potential of 10,000 volts, and stepped up to 33,000 volts for transmission to the two other substations.

RALEIGH, N. C.—The Piedmont Railway & Electric Company, Burlington, having $1,000,000 capital, has been chartered to generate power, operate street railways and interurban lines, and maintain theaters, etc., in addition to doing a general development business. The charter specifies especially the construction of electric lines to connect Burlington, Graham, Haw River, Hopedale, Carolina and Glenco, and operate anywhere in Guilford and Alamance Counties within fifty miles of Burlington. J. M. Cook, Burlington; E. S. Parker, Jr., Graham, and A. L. Davis, Burlington, are the incorporators.

ATLANTA, GA.—The Georgia Railroad Commission has by decision denied the right of the Fulton County Board of Commissioners at Atlanta to grant a fifteen-year franchise to the Georgia Railway & Electric Company for their proposed Burkhead extension on which the maximum fare of five cents from the city limits to the end of the line was fixed, thus refusing what was nominated the "ten-cent car fare," the petition of the electric company for approval of the franchise being denied. The Railroad Commission sets forth that it holds exclusive jurisdiction in law in the matter of maximum rates to be charged, etc. L.

COLUMBIA, S. C.—At a meeting of stockholders, held a few days ago, it was voted to adopt the resolution of the board of directors for an increase in the capital stock of the Columbia Street Railway, Light & Power Company from $1,600,000 to $3,000,000. The question of changing the name of the concern to the Columbia Railway, Gas & Electric Company was also taken up and agreed to, following a resolution to the same effect by the directors at a meeting held April 11. The increase in capital is made to provide funds for improvements in the system. L.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

ESTELLINE, S. D.—The Council has granted a franchise to a local telephone company. C.

HARVEY, N. D.—The County Board has granted a franchise to erect and maintain a telephone line. C.

WAUSAU, WIS.—The Chicago & Wisconsin Valley Telephone Company is planning to build a line to Rothschild. C.

MARIPOSA, CAL.—A. C. Smith and others have secured a franchise for a telephone line along the Mariposa and La Grand road. A.

DULUTH, MINN.—The Zenith Telephone Company will erect a three-story exchange building of pressed brick. The cost will be $50,000. C.

CORNING, CAL.—Joseph P. Tait, representing the Tehama Telephone Company, has been granted a franchise for telephone lines in this city. A.

FAIRVIEW, IND.—The Fairview Mutual Telephone Company has been incorporated with a capital of $5,000 by George Sharp, John Berns and Mack Ellis.

SHUBUTA, MISS.—The Board of Aldermen at the regular monthly meeting granted a franchise to the People's Telephone & Telegraph Company to enter the town.

DES MOINES, IOWA.—The Epworth Rural Telephone Company was incorporated with a capital of $6,000 to do business in Cherokee County. E. H. Mitchell is president.

HENNING, MINN.—The Henning Vining Telephone Company has been incorporated with a capital of $4,000. The incorporators are A. B. Trana, M. B. Lund and John Guisness.

HOUSTON, TEX.—Provision has been made for the installation of a rural telephone system covering the greater part of Brazoria County and portions of Harris and Fort Bend Counties.

MAXVILLE, O.—The Maxville Telephone Company was recently incorporated with a capital of $10,000. The incorporators are S. S. Mohler, Geo. Vanatta, John Bell and J. H. Goodleve.

BUSHYHEAD, OKLA.—The Farmers' Rural Telephone Company has been incorporated with a capital stock of $2,250. The directors are W. J. Strang, W. A. Howard and J. A. Johnston.

OKLAHOMA CITY, OKLA.—The Mackay Telegraph Cable Company has just opened its first office in the state in this city and is pushing a line through to Galveston as rapidly as possible.

PUEBLO, COLO.—The Pueblo Southeastern Telegraph & Telephone Company has been incorporated with a capital of $50,000. The incorporators are J. H. Voorhees, W. D. Garwood and B. H. Tallmadge.

APPLETON, WIS.—The Manitowoc Road Telephone Company, a sub-licensee of the Wisconsin Telephone Company, has been organized to build ten miles of line east of Darbot to connect with the exchange in this city. C.

MONTEREY, CAL.—The work of constructing a forty-mile cross-country telephone line, from King City to Slate's Hot Springs on the Coast sixty-five miles south of Monterey, has begun, Dr. H. C. Murphy, of Salinas, managing the project.

TUCSON, ARIZ.—Preparations are being made for bringing the new long-distance telephone line from Los Angeles into the central station of the Consolidated Telephone, Telegraph and Electric Company in Tucson. The work will be done at once.

BUDA, TEX.—The Buda Telephone Company has been organized with a capital of $5,000. Directors are W. S. Birdwell, L. L. Carter, C. C. Huddleston, J. J. Blanton and J. W. Adair. The new company will make many improvements in the local system, which it purchased.

SALISBURY, N. C.—The Southern Bell Telephone Company has just begun the construction of a new toll line into Cleveland county, some forty miles, where it is said the existing system will be greatly improved. A new line will also be built to Lexington to take care of increased patronage. L.

CALDWELL, IDAHO.—The Bell Telephone Company is installing another line to Parma and one to Notus. The business to these points has become so heavy that additional lines became necessary. An additional line to Middleton will be put in and the Rockville line, which was destroyed by storms will be rebuilt.

LEXINGTON, S. C.—The Farmers' Mutual Telephone Company was organized at Gaston with the following officers: W. B. Fallaw, president; J. H. Price, vice-president; D. M. Craft, secretary, and W. D. Pound, treasurer. It is the intention of the company to erect a line from Gaston to Swansea and other points in the community.

BANDERA, TEX.—The property of the San Antonio & Northwestern Telephone Company was sold at public sale for $6,000, to satisfy a judgment of the Boerne State Bank. The following Boerne people purchased the property: Chas. Reinhard, Rud Aue, Dr. J. F. Nore, Henry and Adolph Wendler and Adolph Luckenbach. At the same time, J. F. Habey bought the Bandera line for $3,400.

SPENCER, N. C.—The Southern Bell Telephone Company has begun work on the rebuilding of its plant here, which will be done at a cost of $18,000. A new and modern common battery system will displace the magneto plant now in use. Several miles of cable will be strung, including a large cable to Salisbury through which all lines will be connected with the Salisbury exchange. The work is being done under the direction of J. L. Moore, division plant superintendent at Charlotte.

ELECTRICAL SECURITIES.

The decision in the Standard Oil case caused a buoyant response in the market for securities. There was a general activity which has been lacking for the past ten months. Steel was easily the leader in volume of trade and it was evident that those who are well informed regard that corporation's operations fairly safe from any such decision as that meted out to Standard Oil, notwithstanding the fact that a new congressional investigation of steel is but begun. The leaders among the stocks showed these net advances for the week: Steel, 4¾; Reading, 4¾; Union Pacific, 6⅞; Southern Pacific, 4⅝; Amalgamated Copper, 4⅞; and Chicago, Milwaukee & St. Paul, 4⅛.

The annual meeting of stockholders of the American Union Telegraph Company will be held at 195 Broadway, New York, May 31.

The Boston Water Power Company has canceled $310,000 of its bonds, leaving $732,000 at present outstanding. The bonds cancelled were used to pay for 284,712 square feet of land purchased from the company at public auction on January 17 last.

The Cleveland Railway is expected to sell an additional $2,500,000 of its newly authorized bonds in the near future to provide money for further improvements and additional rolling stock equipment.

DIVIDENDS.

Brooklyn Rapid Transit Company; quarterly dividend of one and one-quarter per cent, payable June 9.

Brooklyn Union Elevated Railroad; a dividend of two and one-half per cent on the common stock, payable June 7 to stock of record May 31. The regular semi-annual dividend of two and one-half per cent on the preferred was also declared payable June 30 to stock of record June 22.

Cities Service Company; regular monthly dividends of one-half of one per cent on the preferred, and one-quarter of one per cent on the common stock, payable June 1 to stock of record May 10.

Detroit Edison Company; quarterly dividend of one and three-quarters per cent, payable July 15.

Northern Ohio Traction & Light Company; common quarterly dividend of three-quarters per cent, payable June 15.

Philadelphia Electric Company, quarterly dividend of one and one-half per cent, payable June 15.

Winnipeg Electric Company; a quarterly dividend of three per cent, payable July 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	May 22.	May 15.
Allis-Chalmers Common	8	7
Allis-Chalmers preferred	30	26½
Amalgamated Copper	67¼	62½
American Tel. & Cable	*82	82
American Tel. & Tel.	148½	148
Brooklyn Rapid Transit	80½	78¾
General Electric	159¾	156
Interborough-Metropolitan common	18½	18½
Interborough-Metropolitan preferred	52	52
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	91⅞	88¾
Mackay Companies (Postal Telegraph and Cables) preferred	76¼	76¼
Manhattan Elevated	135	134½
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	49½	48
U. S. Steel common	80⅝	75½
U. S. Steel preferred	119¾	118¾
Western Union	77½	73¾
Westinghouse common	73½	67½
Westinghouse preferred	116¾	*110

*Last price quoted.

BOSTON.

	May 22.	May 15.
American Tel. & Tel.	148¾	148⅛
Edison Elec. Illuminating	287	286
General Electric	159½	156
Massachusetts Electric common	19¾	18½
Massachusetts Electric preferred	89	88¼
New England Telephone	145	144½
Western Tel. & Tel. common	18½	19
Western Tel. & Tel. preferred	94	94

PHILADELPHIA.

	May 22.	May 15.
American Railways	44	44
Electric Company of America	12	12
Electric Storage Battery common	54	52¾
Electric Storage Battery preferred	54	52¾
Philadelphia Electric	16¾	16½
Philadelphia Rapid Transit	18⅜	18
Philadelphia Traction	83½	83
Union Traction	46¾	46¼

CHICAGO.

	May 22.	May 15.
Chicago Railways, Series 1	75	80
Chicago Railways, Series 2	21½	20½
Chicago Subway	4¾	4¾
Chicago Telephone	123	122
Commonwealth Edison	127	127
Metropolitan Elevated common	23½	22
Metropolitan Elevated preferred	70½	66

PERSONAL MENTION.

A. W. BURCHARD, of the General Electric Company, sailed for Europe last Wednesday on the Mauretania.

ALEXANDER GRAHAM BELL will be honored at his birthplace, Brantford, Ont., by the erection of a memorial. This ceremony will take place on Dominion Day, July 1, 1912.

IRVING HALE, of Denver, Colo., has been made president of the Colorado Interurban Railway Company, which was organized to build an electric interurban railway between Denver and Longmont.

FRANK H. CUTSHALL, who has been succeeded as general manager of the Chicago, South Bend & Northern Indiana Railway by C. D. Emmons, has been appointed general manager of the Gas Company at Lima, O.

L. H. NEWBERT, manager of the Redwood district of the Pacific Gas & Electric Company, will take charge, on June 1, of the new appliance department of the company. Mr. Newbert's headquarters will be in San Francisco.

PHILIPPE A. GUYE, of Geneva, Switzerland, editor of *Journal de Chemie Physique*, has been awarded the gold medal of the Societe d'Encouragement pour l'Industrie Nationale, of France. The medal was given in recognition of his work on the fixation of atmospheric nitrogen which he carried on for seventeen years.

E. D. NIMS, former president of the Pioneer Telephone Company, has been elected vice-president of the Missouri & Kansas Telephone Company and will have headquarters in Kansas City. C. S. Gleed, president of the Missouri & Kansas Telephone Company, will be president of both companies.

A. G. McCLURE, who has been prominently connected with the conduit industry for a long time, notably with the Safety Insulated Wire & Cable Company and the American Conduit Company, has recently completed a four-months' trip embracing over sixty cities in the Southern, South Western and Central Western states. Mr. McClure has made a careful study of underground conduit and construction and ornamental street lighting systems and conduit work for electric light, telephone and street railway companies, and railway signal departments.

ARTHUR B. LISLE, general manager of the Narragansett Electric Lighting Company, has suffered a terrible bereavement in the death of his only child, W. W. Lisle, a seven-year-old son. The little fellow had been out walking with his grandfather, Henry D. Briggs, and started to dig a hole in a sand bank near Mr. Lisle's home at Chepiwanoxet. Before Mr. Briggs could get to his assistance there was a slide and a huge boulder fell upon the boy. Neighbors rushed to the rescue, but in spite of their heroic efforts at releasing the lad and in applying artificial respiration the little fellow expired before medical assistance could be secured. We join with many friends in extending our deepest sympathy and heart-felt condolences to the bereaved members of the family.

JAMES LYMAN, formerly district engineer for the General Electric Company, Chicago, Ill., has become a member of the firm of Sargent & Lundy, consulting engineers, Chicago, where he will assume the duties of chief engineer of the Electrical Department. Mr. Lyman is one of the pioneers in electrical engineering, having been associated, during the years from 1884 to 1887, with Thomas A. Edison in installing the first lighting plants in Pennsylvania, Maryland and neighboring states. After a period of several years in the manufacturing business Mr. Lyman entered the employ of the General Electric Company, being located first in Schenectady and, for the past sixteen years, in Chicago as district engineer. Mr. Lyman is a graduate of Yale University (Sheffield Scientific School) and has also received a master's degree in electrical and mechanical engineering from Cornell University. He is a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Electrochemical Society, Illuminating Engineering Society, Western Society of Engineers, Chicago Electric Club, University Club, and the Union League Club. Coincident with Mr. Lyman's change is that of W. S. Monroe, formerly in charge of the drafting room of Sargent & Lundy, who has been also taken into the firm and will hereafter assume the duties of chief engineer of the mechanical department, under Mr. Sargent.

OBITUARY.

JOHN M. NATE, well known in the telephone field, died at the home of his daughter, in Winona, Minn., on April 30. Mr. Nate was for many years connected with the Chicago Telephone Company, being its purchasing agent for some time prior to the year 1895. In 1895 he entered into electrical manufacturing and was just before his death manager of the Minneapolis office of the Stromberg-Carlson Telephone Manufacturing Company.

HENRY HUTCHINS SYKES, general manager of the Southern New England Telephone Company, died in New Haven May 18, 1911. He was born in Suffield, Conn., in 1867 and graduated from the Yale scientific school in 1889 and from Boston Technology in 1891. Immediately afterward he went with the American Telephone & Telegraph Company, remaining there until 1895. In that year he was appointed chief engineer of the Bell Telephone Company of Missouri and lived in St. Louis. In 1902 he went to New Haven as general superintendent of the Southern New England and in January, 1907, he was made general manager.

LEGAL NOTES.

GRANT TO POWER COMPANIES NOT APPLICABLE TO TELEPHONE COMPANIES.—An act granting to electric power companies the right to use public highways for poles and wires does not apply to telephone companies whose operations are confined exclusively to telephone service.—Supreme Court of Nebraska in Alt vs. State, 129 N. W. 432.

POWER TO TRANSMIT ELECTRIC CURRENT INCLUDED.—A municipal ordinance empowering a corporation "to lay down in the ground, put on poles and otherwise attach wires to other suitable conductors for the transmission of electricity, upon, over, through, under and in the streets, lanes, alleys and public grounds" of the city, includes power to transmit electric current, using the public way as indicated, for all lawful purposes.—Supreme Court of Wisconsin, in State vs. Kenosha Electric Railway Company, 129, N. W. 600.

RIGHTS OF TELEPHONE VERSUS RAILROAD COMPANIES.—Where a telephone company constructs its lines along a public highway in a proper manner under the terms of a legislative grant and uses them in the public service, a railroad company has no authority, either by itself or by an employe, to treat the wires at a railroad crossing as a nuisance and cut them down, if they do not in any way endanger railroad employes or interfere with the moving of trains, or wth the railroad right of way. In determining the respective rights of a telephone company and a railroad company at a place where the telephone wires on a public highway cross the railroad right of way, the rights of the public, as well as property rights, should be considered.—Supreme Court of Nebraska, in Alt vs. State, 129 N. W. 432.

ELECRICITY IS "MANUFACTURED" AND COMPANIES MAY BE "TRADING COMPANIES."—Unlike the utilization of water and air by simple control and guidance of them to the desired end, commercial electricity is produced by labor, machinery or by chemical combination of various different elements. To do this is the very essence of manufacture—"the making of something from raw materials by hand, by machinery or by art." And, when so manufactured, it cannot be denied that electricity can be bought, sold, measured and delivered. Therefore, companies may make it their principal business to buy, sell, measure and deliver electricity, and in doing so become "trading companies" within the meaning of the bankruptcy law, so as to be adjudged involuntary bankrupts.—United States District Court in West Virginia, In re Charlestown Light & Power Co., 183 Fed., 160.

SUPPLYING ELECTRIC CURRENT A PUBLIC USE.—Although there are some contrary views expressed, the Supreme Court of Tennessee is of the opinion that the supplying of electric current for lighting, heating, and motive power, where all who desire are entitled to demand a supply for such purposes, is, at the present day, a public use, particularly where the opportunities of the company to serve a large portion of the public are apparent and its purposes to do so are conceded. This conclusion is reached in a case where it is held that a demurrer was properly overruled to a petition to obtain land by condemnation for the purpose of taking care of the back flow of waters caused by dams which the company proposed to construct to obtain a sufficient head of water to operate its electrical works. A growing need of the modern community, the court says, is most certainly the need for electric current. Not only as municipalities do we demand such current, for street lightning and the like, not only do our public service corporations require it for transportation of passengers and commodities, but it is demanded in every household, store, factory, and office, and in fact everywhere that light, heat, or motive power is wanted. Its uses are multiplied daily. It has long been held that the supplying of water to a community was a measure of public utility, and the supplying of electricity to a modern community is scarcely less a measure of public utility.—Great Falls Power Company vs. Webb, 133 S. W. 1105.

PROPOSALS.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Place of Delivery.	Schedule No.
June 6—	Switchboards, etc	Miscellaneous	Brooklyn, N. Y.	3615
	Tape, insulating, cotton	1,200 pounds	Norfolk, Va.	3623
	Tape, insulating, rubber	350 pounds	Norfolk, Va.	3623
June 20—	Breakers, circuit	9	Mare Island, Cal.	3627
	Fuses	Miscellaneous	Mare Island, Cal.	3627
	Tape, insulating, cotton	950 pounds	Mare Island, Cal.	3627
	Tape, insulating, rubber	300 pounds	Mare Island, Cal.	3627
	Transformers	3	Puget Sd., Wash.	3612
	Wire, magnet	535 pounds	Mare Island, Cal.	3627
	Wire, resistance	135 pounds	Mare Island, Cal.	3627

POST OFFICE, CLAY CENTER, KAN.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until June 26 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring and lighting

fixtures) of the United States post office at Clay Center, Kan., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Clay Center, or at the Supervising Architect's office.

POST OFFICE, GETTYSBURG, PA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 15 for the construction (including plumbing, gas piping, heating apparatus, conduit and wiring) of the United States post office at Gettysburg, Pa., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Gettysburg, or at the Supervising Architect's office.

NEW PUBLICATIONS.

TERRESTIAL MAGNETISM.—The Department of Commerce and Labor has tabulated the results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1909 and June 30, 1910.

MAGNETIC MEASUREMENTS.—The Coast and Geodetic Survey has issued "Directions for Magnetic Measurements," by D. L. Hazard, computer in the Division of Terrestrial Magnetism. This publication gives the theory of measurements of the earth's field and directions for carrying out such measurements.

BULLETIN OF BUREAU OF STANDARDS.—No. 2 of Vol. 7 of this publication has appeared and contains, among others, the following papers: "The Reflecting Power of Various Metals," and "Selective Radiation from Various Substances," by W. W. Coblentz; "The Measurement of Electrical Oscillations in the Receiving Antenna," and "Some Experiments with Coupled High-Frequency Circuits," by L. W. Austin.

NEW INCORPORATIONS.

BROOKLYN, N. Y.—The United Chandelier Works has been incorporated with a capital of $800 by Harry Berkowitz, Soloman Pascal and Annie Berkowitz, all of Brooklyn.

MILWAUKEE, WIS.—The American Electric Company has been incorporated with a capital of $6,000. The incorporators are T. R. Cook, Asa T. Cook and John A. Wallis.

CLAYTON, WIS.—The Clayton Electric Company was recently incorporated wtih a capital of $2,000. The incorporators are Theodore Erickson, James S. Malchow and C. J. Anderson.

YOUNGSTOWN, O.—The Electric Wiring Company, which will deal in electric supplies, has been incorporated with a capital of $25,000 by C. H. Hood, W. E. Fownes, C. R. Hood and H. W. Fownes.

PASSAIC, N. J.—The Standard Electric & Manufacturing Company has been incorporated with a capital of $100,000 and will engage in an electrical and mechanical contracting and engineering business. The incorporators are Anton Voegtle, Richard H. Voegtle and Hermann J. D. Voegtle.

LAFAYETTE, IND.—The Lafayette Electric Manufacturing Company has filed articles of incorporation with the Secretary of State. The capital stock is $40,000. The object and purpose of this corporation is to manufacture and sell electric appliances and devices of every kind and description, and all machines, tools and instruments pertaining thereto. The incorporators are Albert E. Scheitethe, W. M. Baker and B. P. Shearer. S.

INDUSTRIAL ITEMS.

ROESSLER & HASSLACHER CHEMICAL COMPANY, New York, N. Y., has issued its May price list of chemicals.

WICKES BROTHERS, Saginaw, Mich., has issued its May monthly stock list of machinery bargains. This list contains a great number of pieces of electrical and mechanical apparatus.

THE NATIONAL METAL MOLDING COMPANY, Pittsburg, Pa., has mailed wall hangers listing and illustrating different forms of "National" metal molding. Porcelain rosettes, dead-ends, keyless receptacles, etc., are included.

THE CONDUIT MACHINE COMPANY, St. Louis, Mo., is distributing to the trade small pocket wiring tables which are compiled in very convenient form. The table advertises especially the C-M fishing and threading machine.

ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, Boston, Mass., recently distributed Bulletin No. 19 on line material for electric railways. Practically all the material listed is of the company's own manufacture, and is a result of sixteen years' experience in this line of work.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, O., continues in the May number of *Common Sense* the article on "Automatic Magnetic Control." Former articles of this series have appeared in the issues of the four preceding months.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has reproduced in bulletin form a series of talks and illustrations of railroad electrification which have appeared in the technical magazines between January 1 and March 1, 1911. This publication is listed as circular No. 1517 and will be sent on request.

THE HURLEY MACHINE COMPANY, Chicago, Ill., is mailing to the central stations a proof of an electrotype which it will send to those desiring it for use in connection with newspaper advertising. The electrotyped advertisement is in the form of a six-picture cartoon illustrating the great convenience of the Thor electric laundry machine.

PARTRICK, CARTER & WILKINS COMPANY, Philadelphia, Pa., suffered considerable damage from a fire which, on the night of May 16, occurred in its factory. The company announces that the facilities will in a short time be so readjusted as to permit of the prompt filling of orders, and asks for the present the indulgence of its customers.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces that its heating appliance department has been moved to New York City, where more space was available. The sales offices, located in the Times Building, at Broadway and Forty-second Streets, are in charge of George B. Katzenstein, manager of the department.

THE MESTA MACHINE COMPANY, Pittsburg, Pa., has distributed a bulletin describing and illustrating the Mesta horizontal double-acting four-cycle gas engine. An interesting comparison of the economy of gas and steam engines is made in the publication, a chart being included to show the losses in both engines and the power finally available at the shaft of each.

MATHIAS KLEIN & SONS, Chicago, who have made the Klein line of construction tools since 1857, have been appointed sole distributors for the "P. & G." wire skinner. This handy little tool is meeting with great favor among electricians, line men, telephone men, fixture hangers and others. M. Klein & Sons will be glad to mail descriptive circular of this device on request.

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT, Berlin, Germany, has issued bulletins describing its iron resistances for self-regulation of current under variable voltage, columns for switchboard instruments, turbo-compressors, motor-generators, arc lamps for color matching, bell-ringing transformers, and motors for planers and other machines and devices requiring automatic reversal.

THE JEFFERSON GLASS COMPANY, Follansbee, W. Va., manufacturers of Luceo reflectors for tungsten lamps, has established a new office at 24 East Adams Street, Chicago, Ill., with R. A. L'Ecuyer in charge. The company has recently added Luceo ball globes for 100, 150, 250, 450 and 500-watt lamps and the Luceo ceiling bowls, as well as a line of Luceo reflectors of larger dimensions.

THE WILLARD STORAGE BATTERY COMPANY announces that, owing to increasing business, it has been found necessary to secure larger quarters for the accommodation of the Detroit branch. These have been obtained at 1191 Woodward Avenue, Detroit, Mich., where a sales room and fully equipped battery repair department are ready for business. This branch is in charge of Max G. Hilman.

THE J. FAESSLER MANUFACTURING COMPANY, Moberly, Mo., makers of "Boss" and "Universal" flue expanders, flue cutters and other boiler tools, have reorganized their sales department and placed Charles F. Palmer in charge as sales manager, with an office at 810 Olive Street, St. Louis. Mr. Palmer is well qualified for this position through previous experience in selling Faessler tools and as representative of the Frank E. Palmer Supply Company, of St. Louis.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has mailed cards bearing the announcement that it is prepared to furnish three-wire direct-current generators for practically any capacity. The neutral in this form of generator is obtained from an additional generating winding in the armature, this winding being connected to a single collector ring. The advantages of this design of generator are said to be: high efficiency, great overload capacity, and simplicity.

FRANCIS P. MANN, 12 Boulevard Arago, Paris, France, has made an arrangement with M. Herrgott, the inventor of electric-heating fabrics, a description of which was published in a recent issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, to represent him for any business developed in America, either as to orders for such material or as to forming a branch company or agency. Catalogs in English are now ready and will be furnished by Mr. Mann upon request.

THE MORRIS IRON COMPANY, of 86 West Street, New York City, recently received two important contracts for lighting by means of combination trolley and lighting poles. These are to be installed at Joliet, Ill., and Texarkana, Tex. Previous installations of similar posts have been made by this company at Lincoln, Neb., Poughkeepsie, N. Y., and Portland, Me., and undoubtedly at least a dozen cities will have adopted this form of lighting during the present year.

THE OSHKOSH LOGGING TOOL COMPANY, Oshkosh, Wis., announces its consolidation with the A. Stanford Logging Tool Company and the Oshkosh Tool Manufacturing Company, both of Oshkosh. The new corporate name will be the Oshkosh Manufacturing Company. The Stanford Company was organized in 1853 to manufacture labor-saving tools and devices. The Oshkosh Logging Tool Company was organized in 1885 and although manu-

facturing lumbermen's tools, made a specialty of labor-saving tools and devices for telephone and telegraph companies and electrical contractors. The consolidation of these two companies, together with the Oshkosh Tool Manufacturing Company, will give impetus to this line of business.

THE WALPOLE RUBBER COMPANY and THE MASSACHUSETTS CHEMICAL COMPANY announce that their Chicago offices are now located in the Brooks Building, at the corner of Jackson Boulevard and Franklin Street.

DATES AHEAD.

American Society of Mechanical Engineers. Spring meeting, Pittsburg, Pa., May 30 to June 2.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Commercial Section, National Electric Light Association. Meeting and banquet, New York, N. Y., June 1.

National District Heating Association. Annual meeting, Pittsburg, Pa., June 6-8.

Canadian National Electrical Credit Association. Toronto, Ont., June 13-16.

American Society of Civil Engineers. Annual convention, Chattanooga, Tenn., June 13-16.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

National Gas and Gasoline Engine Trades Association. Convention, Detroit, Mich., June 19-23.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass. June 19-23.

Michigan Electric Association. Annual convention, on board steamer *Minnesota*, leaving Grand Haven, Mich., June 19, returning to St. Joseph, Mich. June 22.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

American Institute of Electrical Engineers. Annual convention, Chicago, Ill., June 26-30.

American Society for Testing Materials. Annual meeitng, Atlantic City, N. J., June 27 to July 1.

American Chemical Society. Annual meeting, Indianapolis, Ind., June 28-30.

National Electrical Contractors' Association. Niagara Falls, N. Y., July 19.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 25-28.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9 to 13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) May 16, 1911.

992,165. TELEPHONE SYSTEM. Henry P. Clausen, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Filed March 17, 1902. A supervisory lamp signal is controlled by a supervisory relay and a supplemental relay.

992,168. SPARK-PLUG. James R. Coyle, Huntsville, Ala., assignor of one-half to Elmore J. Mitchell, Huntsville, Ala. Filed June 28, 1910. The central electrode has two adjustable coaxial sections with the adjacent ends meeting in a glass tube.

992,174. TROLLEY-GUIDE. Edward De Planque, Philadelphia, Pa. Filed Sept. 22, 1910. On each side of the trolley harp are guide members with fingers at their forward ends projecting beyond the trolley wire.

992,201. SYSTEM OF ELECTRIC-MOTOR CONTROL. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed June 8, 1907. A three-phase motor is connected to its supply through intermediate steps on a transformer and a set of resistances, all connections being made in succession by remote-control switches governed so as to prevent excess current.

992,202. SYSTEM OF ELECTRIC-MOTOR CONTROL. Henry D. James, Pittsburg, and Edwin Lehr, Wilkinsburg, Pa., assignors to Westinghouse Eletric & Manufacturing Co. Filed Sept. 3, 1907. A polyphase induction motor has two independent magnetic reversing switches and a set of magnetic switches for cutting out the secondary resistance, each of the latter switches having three magnet windings, two of which are first placed in series across one phase and then all are connected in polyphase manner as the switch is closed.

992,214. ELECTROPNEUMATIC BRAKE. Louis Alfred Larivière, Paris, France. Filed June 13, 1910. An electromagnet under the control of the locomotive operator has a core for operating inlet and release valves.

992,217. UNIT SWITCH-CONTROL SYSTEM FOR ELECTRIC MOTORS. Edwin Lehr, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed June 8, 1907. A series of resistance-controlling switches for the rotor of a polyphase induction motor has combined with it a series relay switch and a number of intermediate relay switches that alternately delay the action of the successive control switches to permit the series relay switch to act after each control switch is closed.

992,226. AUTOMATIC CONTROLLER FOR ELECTRIC ELEVATORS. William McDonald, Unionport, N. Y. Filed Feb. 17, 1911. In a traction elevator having a driving and an idler sheave, the shafts of these sheaves are connected by a sprocket chain which is adapted to open a switch in the main circuit when there is a difference of speed between the sheaves.

992,236. RAILWAY SIGNALING APPARATUS. Walter P. Neubert, Swissvale, and William H. McClelland, Jr., Wilkinsburg, Pa., assignors to Union Switch & Signal Co., Swissvale, Pa. Filed Dec. 30, 1909. Includes a contact-making device with two arms rotatable in both directions for engaging two sets of contacts.

992,273. DEVICE FOR ADJUSTING SUSPENDED ELECTRIC LAMPS. Samuel Singer, Brooklyn, N. Y. Filed Jan. 3, 1911. A lamp-cord adjuster has a block in two parts, one having two recesses into which fit the arms of the other part.

992,280. POLYPHASE MOTOR. Simon Sparrow, St. Louis, Mo., assignor to Wagner Electric Manufacturing Co., St. Louis, Mo. Filed April 30, 1910. The rotor has a single distributed closed-coil winding, some parts of which are permanently short-circuited and other parts are arranged to be short-circuited.

992,281. ELECTRIC FURNACE. Eben C. Speiden, Niagara Falls, N. Y., assignor to International Acheson Graphite Co., Niagara Falls, N. Y. Filed Jan. 31, 1911. Has overlapping electrodes inclined above a zone of maximum temperature development, the working ends of the electrodes being at the apices of an approximately equilateral triangle.

992,289. MULTIPLE-VOLTAGE CONTROLLER. Emmett W. Stull and George B. Schley, Milwaukee, Wis., assignors to Allis-Chalmers Co. Filed Sept. 30, 1909. A controller is arranged to change the connections of the motor armature from one set of mains to another of lower voltage while maintaining the continuity of the circuit and as such change is being made to insert, by means of a lever arrangement, resistance temporarily in the armature circuit and in series with the main to which an armature terminal is being changed.

992,294. MOTOR-STARTER OR ELECTRIC-CIRCUIT CONTROLLER. George G. Thompson, Muskegon, Mich., assignor to American Electric Fuse Co., Muskegon, Mich. Filed Dec. 31, 1910. Has a pair of resistances each made up of a pile of carbon disks mounted on the back of the starting plate, which has a control lever on its face.

992,300. ELECTROMAGNETIC APPARATUS. Miles Walker, Manchester, England, assignor to Westinghouse Electric & Manufacturing Co. Filed Dec. 16, 1905. Combines with a magnetizable core, of a continuous conductor surrounding the core, and comprising two paths of unequal resistance which are responsive to an alternating current for producing a magnetic field of constant poliarity in the core.

992,301. CABLE OR CONDUCTOR HANGER. John J. Walsh, Yonkers, N. Y. Filed April 24, 1908. Has a conductor-receiving hook of sheet-metal with stiffening flanges and a movable closure for the hook.

992,302. ELECTRIC MACHINE FOR THERAPEUTIC PURPOSES. Reinhold H. Wappler, New York, N. Y., assignor to Wappler Electric Manufacturing Co., New York, N. Y. Filed Oct. 11, 1910. Includes a current rectifier comprising a rotor of insulating material, diametrically opposed sets of posts carried by it, a conductive segment secured to the posts of each set at a distance from the rotor, and conductors co-operating with the segments.

992,305. SWITCH-CONTROLLER. Harold D. Waterhouse, Quincy, Mass., assignor to Lamson Consolidated Store Service Co., Neward, N. J. Filed Feb. 27, 1906. A pneumatic-tube parcel-delivery system has a central selecting switch electrically connected to switches at each of the substations for diverting the carrier at any of these points.

992,306. CLUSTER LAMP-SOCKET. Nelson Weeks, Richmond,

Hill, N. Y., assignor to Benjamin Electric Manufacturing Co., Chicago, Ill. Filed May 17, 1904. A plural lamp socket has a central block carrying circuit terminals.

992,333. ELECTRIC EXCHANGE SYSTEM. Alexander T. Brown, Syracuse, N. Y., assignor to Wilbert L. Smith. Filed May 28, 1895. Renewed July 16, 1910. Comprises a series of metallic circuits connecting the subscribers to the main exchange, one of these circuits having an automatic controlling device. A motor intermittently connects the circuits at the exchange.

992,360. TROLLEY-POLE-CONTROLLING MECHANISM. Michael Kern, Chicago, Ill. Filed Aug. 23, 1909. A mining locomotive has its trolley pole held against the wire by a spring-pressed arm bearing against it.

992,366. AUTOMATICALLY-OPERATED ILLUMINATED ADVERTISER. Luther L. Mack and Ralph D. Horton, Longbeach, Cal., assignors to General Appliance Manufacturing Co., Los Angeles, Cal. Filed Feb. 23, 1910. Motor-driven ratchet wheels carry an endless chain slide carrier in front of a projecting lamp.

992,372. COMMUTATOR. Emil Mattman, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed Aug. 6, 1909. Comprises a number of bars, a spider for supporting the bars, and a member provided with slots and secured to the spider to prevent injurious matter from coming in contact with the bars, the slots being arranged to permit axial shifting of the member.

992,374. AUTOMATIC BLOCK-SIGNAL JOINT. William McGuire and Lloyd H. Kinney, Clifton, Pa. Filed July 9, 1910. An insulated rail joint has strips of insulating material between the splice bars and rail ends.

992,397. INSULATOR. Milton E. Anderson, Louisville, Ky. Filed August 18, 1910. Consists of two sections, the lower one fitting over the supporting pins having itself a central pin on which the top section is secured.

992,417. ELECTRIC TOASTER AND GRIDDLE. Horace B. Gale, Natick, Mass., assignor to Simplex Electric Heating Co., Boston, Mass. Filed Nov. 16, 1909. An electrically heated table is provided with hinged electrically heated plates. The bread to be toasted is placed between the table and plate, the plate adjusting itself automatically into direct contact with all parts of the adjacent side of the bread irrespective of the thickness within considerable limits.

992,427. MEANS FOR CONVERTING ELECTRICAL ENERGY INTO MECHANICAL MOVEMENT. William Jandus, Cleveland, O. Filed Nov. 24, 1902. The combination with suitable supporting means, of an electro-thermic element consisting of two base members mounted upon the supporting means so as to be oscillatory about angularly related axes and a multiplicity of conductor-members connected in series electrically, and having their ends fixedly secured to such base members.

992,455. OPERATING DEVICE FOR STREET AND STATION INDICATORS. Perry T. Spindler, Chicago, Ill., assignor to American Street & Station Indicator Co., Chicago, Ill. Filed June 2, 1910. A switch is automatically opened after each stroke of the operating lever, this lever being actuated by electromagnetic means.

992,460. MEANS FOR DETECTING AND INDICATING TILE-WARPAGE. William B. Updegraff, New York, N. Y. Filed Dec. 15, 1910. The tile to be tested is laid flat on three contact points. A lever provided with a number of contacts is displaced by any tile which, being placed on the three points, varies from a plane surface by more than the determined amount, and the circuits to electromagnets are thus closed.

992,462. INSULATOR. William Weicker, Hermsdorf, Germany, assignor to Portzellanfabrik Kahla, Hermsdorf, Germany. Filed May 11, 1907. Has a body portion of non-conducting material, a comparatively flat dome-shaped top or roof secured to the insulator and a conductor secured to the under face of the roof and adapted to connect the conductor that is to be supported by the insulator.

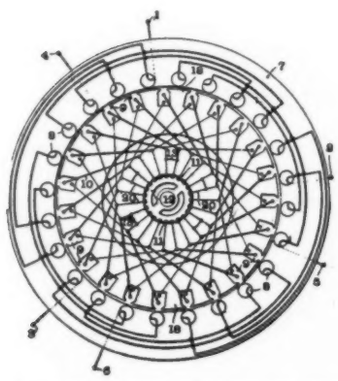
992,468. SIGN-FLASHER. Oliver D. Ziegler, Chicago, Ill. Filed Oct. 13, 1910. A rotating wheel is provided with adjustable pins which throw a pivoted knife switch into contact with a switch point, or out of contact, according as the pins are set.

992,477. AUTOMATIC FIRE-ALARM. Henry Becker, Newport, Ky. Filed Oct. 21, 1910. A bulb and tube filled with mercury is arranged with connecting wires so that contact is made when the mercury expands.

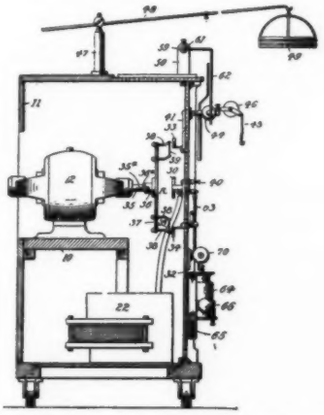
992,478. ELECTRIC SWITCH AND CUT-OUT DEVICE. Robert Birnn, New York, N. Y., assignor of one-half to Isidor Gluck, New York, N. Y. Filed March 24, 1910. Comprises a base block having parallel grooves, plates secured in the opposite end portions of the grooves and provided with binding posts, spring-contact arms arranged in pairs, connected with the plates and extending inwardly toward the center of the block in the grooves, and an insulating block movable longitudinally of the base block.

992,479. ARC-LAMP. André Blondel, Paris, France, assignor to General Electric Co. Filed Jan. 15, 1906. The electrodes are inclosed in an air-tight transparent or translucent envelope. There is also a conduit for the gases evolved at the arc, leading from a point above the arc to a point below the arc, in which the gases are confined, whereby the gases circulate without coming into contact with the walls of said envelope.

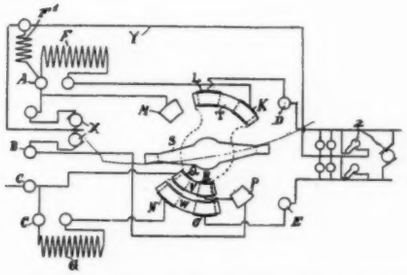
992,484. TROLLEY-WHEEL. John A. Deady, Milldale, Conn. Filed Oct. 3, 1910. The wheel contains a concentric oil chamber having oil-deflecting ribs so that the oil is led to the outer bearings.



992,280.—ROTOR FOR POLYPHASE MOTOR.



992,302.—ELECTRO-THERAPEUTIC MACHINE.



992,539.—TEST SWITCH FOR WATTMETER.

992,539. TEST-SWITCH FOR RECORDING-WATTMETERS. Hans Georg Blokusewski, Weehawken, N. J. Filed June 25, 1909. A device for testing a customer's wattmeter without interruption of his service.

992,541. THERMOSTAT. Melancthon J. Briggs, Philadelphia, Pa. Filed June 8, 1908. A lever conductor having two arms of unequal length is fixed on the base of a hermetically closed tube. The short arm is actuated by the contraction or expansion of the tube causing the long arm to make an electrical contact.

992,542. THERMOSTAT. Melancthon J. Briggs, Philadelphia, Pa. Filed Oct. 22, 1908. A modification of the preceding patent.

992,548. FIELD-MAGNET STRUCTURE. Walter P. Dandliker, West Allis, Wis., assignor to Allis-Chalmers Co. Filed April 19, 1909. Coil-bracing plates between the field magnets are automatically tightened during the operation of the machine.

992,566. STEAM-TURBINE. Duston Kemble, Lakewood, Ohio. Original application filed Feb. 8, 1909. Divided and this application filed April 13, 1909. A valve for each nozzle has an electrical device to operate the same, combined with a governor and an electrical switch and resistance coils electrically connected therewith to variably control the current proportionately to the number of the valve-operating devices in circuit.

992,570. INSULATOR. Harley R. Markel, Columbus, Ohio. Filed July 1, 1910. Comprises two identical L-shaped sections, the central meeting walls being flat and vertical, and the horizontal meeting walls having transverse registering grooves.

992,583. POWER SYSTEM. Alexander Holley Olmsted, Havre, France, assignor to Westinghouse Electric & Manufacturing Co. Filed Sept. 26, 1910. An electrically propelled train comprises a plurality of vehicles, an engine on each vehicle, gen-

erators driven respectively by the engines, propelling motors for the vehicles, respectively supplied from the generators upon the same vehicles as are propelled thereby, and means for controlling the operation of the engines and motors from a predetermined point on the train.

992,595. INSULATOR-LINE-ATTACHING DEVICE. Lertin W. Ridenour, Gratis, Ohio. Filed July 23, 1910. A slip tie made of a single piece of wire is fastened to an insulator.

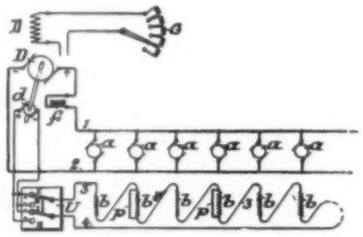
992,628. ELECTRICAL DISTANCE CONTROL. Albert Aichele, Baden, Switzerland, assignor to Aktiengesellschaft Brown, Boveri & Cie., Baden, Switzerland. Filed Sept. 24, 1909. Has a motor, two sets of contact terminals to which correspondingly variable voltages are supplied, switch arms to engage the respective sets of terminals, one of which is operated by the motor in accordance wth the direction and extent of manual movement of the other arm.

992,631. TIME CIRCUIT-CONTROLLER. Walter P. Allen, Philadelphia, Pa. Filed Feb. 24, 1910. Comprises a rocking time element whose content flows more easily in one direction than in the other, means for partially rocking said element, permitting it to continue the rocking by reason of the movement of the content, a weight and means carried by the rocking element for lifting the weight during the time of its rocking movement.

992,633. BREAK-GLASS FIRE-ALARM. Charles Auth, New York, N. Y. Filed June 11, 1910. When the glass of the alarm is broken, two contact points are allowed to come together.

992,636. INCANDESCENT-ELECTRIC-LAMP OR LIKE HOLDER. Heinrich Otto Beige, Halle-on-the-Saale, Germany. Filed Aug. 11, 1910. Combines a sleeve for receiving the base of the lamp, a plug removably insertible in the sleeve and through which the supply conductors can be led, a pillar on the plug, the end of which forms the central contact and a lateral projection on the plug forming a terminal and a connection to the sleeve.

992,682. MEANS FOR OPERATING ELECTRIC MOTORS DRIVING MOTOR-TRAINS. Wilhelm Adolf Theodor Muller, Berlin-



992,682.—MOTOR CONTROL.

Steglitz, Germany. Filed March 1, 1911. A motor-driven generator set supplies current to the armatures of all the motors on the train, all of which are in parallel. Speed is regulated by the variation of the motor fields, and by variation of the generator voltage.

992,711. APPARATUS FOR ELEVATING WATER. Nat H. Freeman, Boulder, Colo. Filed June 4, 1908. The valve-operating mechanism of the elevating tanks is operated by electromagnets.

992,713. TROLLEY-WHEEL. James R. Gilman, Louisville, Ky., assignor to Charles L. Redding, Louisville, Ky. Filed Jan. 4, 1910. The trolley wheel runs on ball bearings.

992,715. ELECTRIC HEATER. Cornell S. Hawley, Albany, N. Y., assignor to Consolidated Car Heating Co. Filed Jan. 23, 1911. The heating elements are surrounded by two perforated walls, the perforations in one wall being opposite an unperforated portion of the other wall, both of the walls being also provided with air admission openings.

992,728. ELECTRIC HEATER. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Co. Filed Jan. 23, 1911. Has a casing with openings for the emission of heat, and a deflector plate supported by one wall of the casing and covering the openings but separated by an air space from the portion of the wall of the casing in which the openings are formed.

992,737. ALARM FOR DRIP-PANS. Clarence T. Mallett, Providence, R. I., assignor of one-half to Alexandre Buzenac, East Providence, R. I. Filed Dec. 19, 1908. A float supported by the water in a drip-pan makes an electric contact, ringing a bell, when the water reaches a certain height.

992,744. LIGHTNING-ARRESTER. Elmer E. F. Creighton, Schenectady, N. Y., assignor to General Electric Co. Filed Feb. 7, 1907. Comprises a rotary member submerged in oil, a tripping means actuated by an electromagnet, a condenser in shunt with the electromagnet, and an electrolytic cell in series with the switch.

PATENTS THAT HAVE EXPIRED.

The following is a list of the electrical patents (issued by the United States Patent Office) that expired May 22, 1911:

520,033. ELECTRIC BATTERY. William W. Burnham, Newton, Mass.

520,050. SYSTEM OF ELECTRIC CONVERSION AND DISTRIBUTION. Thomas H. Hicks, Detroit, Mich.

520,061. RAILWAY SIGNAL DEVICE. Frank E. Kinsman, Plainfield, N. J.

520,062. APPARATUS FOR CONTROLLING THE MOVEMENT OF RAILWAY TRAINS OR VEHICLES. Frank E. Kinsman, Plainfield, N. J.

520,072. PEDAL-GOVERNOR FOR ELECTRIC MOTORS. Arthur G. McKee, State College, Pa.

520,083. TELEPHONE TRUNK-LINE SYSTEM. John I. Sabin and William Hampton, San Francisco, Cal.

520,086. TELEPHONE. Harry F. Slocum, New York, N. Y.

520,088. INCANDESCENT LAMP. Frank S. Smith, Pittsburg, Pa.

520,095. CIGAR-LIGHTER. Eugene T. Turney, Chicago, Ill.

520,108. ELECTRICAL TRAIN-BRAKE. Wendell C. Fletcher, St. Louis, Mo.

520,111. ELECTRIC LOCOMOTIVE. Rudolph M. Hunter, Philadelphia, Pa.

520,116. ELECTRICAL PRIMER. William Mason, New Haven, Conn.

520,120. GALVANIC BATTERY. Edwin F. Northrup, Ardmore, Pa.

520,127. ELECTRIC ANNUNCIATING APPARATUS. Horace E. Walter, Richfield Springs, N. Y.

520,128. SWITCHBOARD FOR HIGH-TENSION CIRCUITS. James J. Wood, Fort Wayne, Ind.

520,129. ELECTRIC CURRENT-INDICATOR. James J. Wood, Fort Wayne, Ind.

520,143. FORMER FOR WINDING ARMATURE-COILS. Harry L. Kirker and William Chambers, Pittsburg, Pa.

520,152. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR. Robert K. Welch, Philadelphia, Pa.

520,156. ELECTRIC-RAILWAY TROLLEY. Thomas M. Brown, Cleveland, Ohio.

520,169. BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES OR MOTORS. Andrew L. Riker, New York, N. Y.

520,184. ELECTRIC CLOCK STRIKING MECHANISM. Fred L. Gregory, Chicago, Ill.

520,223. ELECTRIC ADVERTISING OR SIGNALING APPARATUS. George L. Schneider, San Francisco, Cal.

520,228. ELECTRIC LOCOMOTIVE. Rudolph Eickemeyer, Yonkers, N. Y.

520,232. ELECTRIC-ARC LIGHTING SYSTEM. Daniel Higman, Boston, Mass.

520,234. INDICATOR FOR FIRE-ALARM OR OTHER PURPOSES. William H. Kirnan, Bayonne, N. J.

520,246. AUTOMATIC TELEPHONE SYSTEM. Louis E. Simoneau, Montreal, Canada.

520,253. ELECTRIC HEATER FOR CAR SAND-BOXES. John M. Christopher, Baltimore, Md.

520,263. CARBON SWITCH. Friedrich von Herner-Alteneck, Berlin, Germany.

520,264. COMMUTATOR. Carl Hoffman, Berlin, Germany.

520,267. ELECTRICAL-GOVERNOR. William H. Miller, New York, N. Y.

520,274. ELECTRIC RAILWAY. Ernst W. von Siemens, Berlin, Germany.

520,279. ELECTRIC SWITCH. Henry E. Werline, Lancaster, Pa.

520,280. AUTOMATIC DEVICE FOR REMOVING RESISTANCES IN STARTING ELECTRIC MOTORS AND REPLACING SAME. George H. Whittingham, Baltimore, Md.

520,299. APPARATUS FOR HEATING METAL ELECTRICALLY. Charles L. Coffin, Detroit, Mich.

520,300. METHOD OF HEATING, WELDING OR WORKING METALS ELECTRICALLY. Charles L. Coffin, Detroit, Mich.

520,304. CONDUIT ELECTRIC RAILWAY. William R. De Voe, Shreveport, La.

520,306. TELEPHONE-TRANSMITTER. Henry M. Goodman and John Goodman, Louisville, Ky.

520,316. MOTOR. Charles W. Johnston, Philadelphia, Pa.

520,323. BLOCK SYSTEM FOR TROLLEY-RAILWAYS. Willard F. Lewis, Swampscott, Mass.

520,340. ELECTRIC TRACTION APPARATUS. Paul Schoop, Zurich, Switzerland.

520,351. ELECTRICAL-CONTACT MECHANISM. John F. Blake, New Haven, Conn.

520,356. CONDUIT ELECTRIC RAILWAY. Guarantee Trust and Safe Deposit Co., Philadelphia, Pa.

520,359. APPARATUS FOR ELECTRIC WELDING. Rudolph M. Hunter, Philadelphia, Pa.

520,360. APPARATUS FOR ELECTRIC WELDING. Rudolph M. Hunter, Philadelphia, Pa.

520,361. ELECTRICAL MEASURING INSTRUMENT. Rudolph M. Hunter, Philadelphia, Pa.

520,365. VISIBLE SIGNAL DEVICE. William H. Lane and Frederic S. Perkins, New York, N. Y.

520,367. INSULATOR. Fred M. Locke, Victor, N. Y.

520,378. MULTIPLE-ELECTRIC-FUSE BOX. Edward A. Parson, Ottawa, Canada.